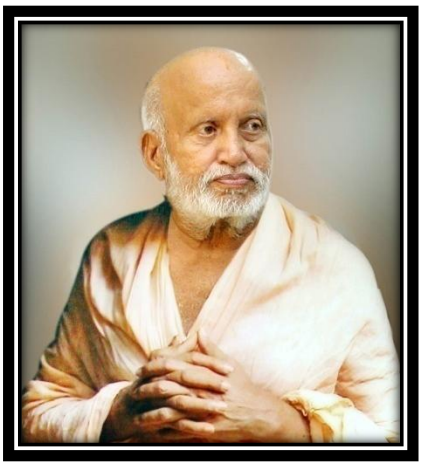
Poornaprajna Institute of Scientific Research Bengaluru, India

Annual Report 2024-2025

Promoted & managed by Admar Mutt Education Foundation
Recognized by Dept. of Scientific & Industrial Research, GOI and Manipal Academy of Higher Education (MAHE) Deemed to be University

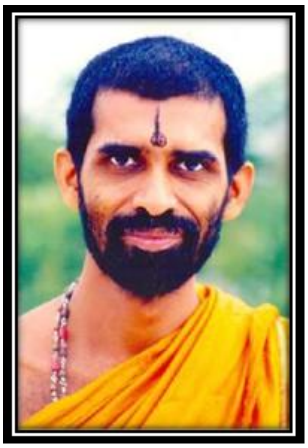
Founder's Message



Knowledge is the true strength of a nation. To unlock India's full potential, it is essential to provide world-class facilities for research in the basic sciences. Today, many of our brightest young minds leave the country in pursuit of opportunities abroad, often settling there permanently. Unless we address this trend, India's progress will remain incomplete. With this vision, the Poornaprajna Institute of Scientific Research (PPISR) has been established under the guidance of some of the most eminent scientists of our nation. Every investment in science and technology is an investment in India's future, strengthening our capacity to innovate, compete, and lead globally. We invite all well-wishers and supporters to join hands in this noble endeavour—to build a self-reliant Bharat, empowered with knowledge, skill, and technology, ready to serve humanity**.** With divine blessings, may we find the strength and wisdom to nurture PPISR into a beacon of excellence for our nation and the world.

H H Shree Vibudhesha Theertha Swamiji,
Founder, PPISR

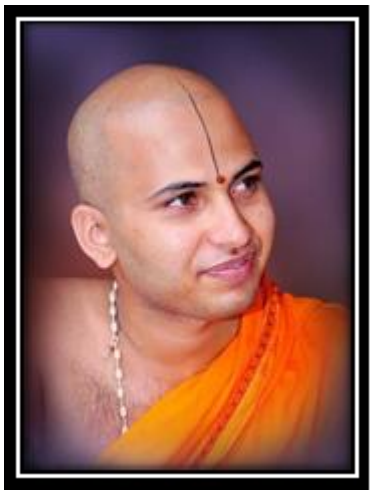
H.H.Shree Vishwapriya Teertha Swamiji's Message



Founded by my revered Guruji, the illustrious H. H. Shree Vibudhesha Theertha Swamiji, the Poornaprajna Institute of Scientific Research (PPISR) stands as the *crest jewel (chuḍāmaṇi)* of the Poornaprajna academic family. True to his vision, PPISR is steadily advancing toward becoming a world-class center of excellence in Physical, Material, and Biological Sciences. Research at PPISR is pursued not merely as a profession, but with profound curiosity and a spirit of service to the Motherland, echoing the legacy of the Vedantic Ṛiṣhis of ancient times, who explored the frontiers of spiritual knowledge with devotion and rigor. Today, several pioneering research projects are underway, driven by capable and dedicated scientists and staff who carry this torch forward with passion and perseverance. I am confident that their collective efforts will fulfill Swamiji's dream—placing India at the forefront of global scientific progress. Indeed, we now have the audacity to hope that PPISR will one day nurture a Nobel laureate. May Lord Shree Krishna continue to bless, guide, and inspire every member of PPISR in this noble journey.

H. H. Shree Vishwapriya Theertha Swamiji
Former-Chairman, AMEF

Chairman's Message



With an academic grounding in both traditional wisdom and modern technology, I feel deeply blessed to walk in the footsteps of my beloved Guruji, H. H. Shree Vishwapriya Theertha Swamiji, as I witness and oversee the remarkable academic strides of the Poornaprajna Institute of Scientific Research (PPISR) - an institution founded with the noble vision of the patriot saint, H. H. Shree Vibudhesha Theertha Swamiji.

What began as a modest initiative with a single department in Theoretical Sciences has today blossomed into a thriving institution with two well-established departments - Materials Sciences & Catalysis, and Biological Sciences. Here, frontier research is advancing in diverse areas, from industrial-grade catalysts to protein structure analysis, reflecting both intellectual curiosity and a deep commitment to societal good. Research at PPISR extends to medicinal applications, green chemistry, renewable energy, and cryptography, while the Materials Sciences and Catalysis group has made significant progress in specialty chemicals, and hydrogen generation.

Equally heartening is PPISR's vision to integrate emerging frontiers like machine learning and artificial intelligence (AI) into its research—whether in catalysis design, immunity-boosting molecular studies, novel solar energy materials, or quantum technologies. With over 428 high-quality publications and 32 successful Ph.D. graduates in a relatively short span, the institute has firmly established itself as a hub of excellence. Recognizing this momentum, the management has invested in expanding facilities, faculty strength, and student scholarships, ensuring that PPISR continues to scale greater heights.

May the divine blessings of Lord Shree Krishna ever guide and inspire the PPISR family—both scientifically and spiritually—as they march forward to fulfill this noble vision.

H.H. Shree Eeshapriya Theertha Swamiji
Chairman – AMEF

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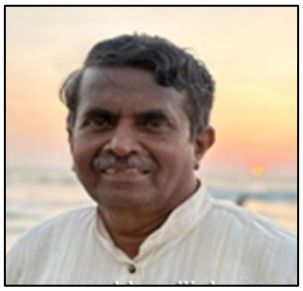

Among the spiritual leaders of our country, His Holiness Shree Vibudhesha Theertha Swamiji, the then Chief Pontiff of Udupi Shree Admar Mutt, stands uniquely as the founder of a thriving scientific research institute—Poornaprajna Institute of Scientific Research (PPISR). His deep curiosity led him to engage with scientists, often attending lectures as a humble student. His vision extended beyond scientific excellence to the unification of science and spirituality, echoing the wisdom of ancient Rishis.

Of the thirty-three Poornaprajna institutions he established across India, each distinguished in its own right, PPISR—founded in Bidalur, Bengaluru in 1998—was his "choodamani," or crest jewel. It symbolizes his profound love for science and his commitment to societal upliftment through knowledge. Swamiji was not only an idealist but also a pragmatic planner, ensuring PPISR's emergence as a premier institute producing high-quality Ph.D. scholars.

Since His Holiness attained the Lotus Feet of Lord Shree Krishna, the sacred mantle of guiding PPISR has been graciously carried forward by His Holiness Shree Vishwapriya Theertha Swamiji, the present Pontiff of Shree Admar Mutt, Udupi, and the President of AMEC and Chairman of AMEF.

Among PPISR's recent achievements, it is noteworthy that 32 doctoral scholars have earned their Ph.D. degrees and moved on to postdoctoral research at esteemed institutions in India and abroad. The institute has also surpassed 420 publications in internationally reputed peer-reviewed journals.

Guided by the sacred vision of H.H. Shree Vibudhesha Theertha Swamiji and the continued blessings of H.H. Shree Vishwapriya Theertha Swamiji and H.H. Shree Eeshapriya Theertha Swamiji, PPISR's activities are primarily funded by AMEF. A significant portion of student scholarships is supported through academic and industrial research projects.

We earnestly hope these achievements inspire greater support from the corporate sector and the general public, strengthening our mission to serve global scientific progress through Indian science.

Dr. A. P. Bhat
Professor and Principle (Rtd), PP College, Udupi, Hon. Secretary, USAMEC & AMEF

Foreword from the Director (Former)

This year, we continued our pursuit of excellence, reaching new milestones in both academic and sponsored research projects. The year began with challenging projects with SABIC Agri-Nutrients Company and SABIC Research and Technology Private Limited. Both projects were successfully completed by year-end. Additionally, four projects were initiated sponsored by DST-SERB on quantum physics, topological states of quantum matter, and hydrogen production through sunlight harvesting. In 2024, the institute published 26 research papers in prestigious international journals and filed two patents. One of our doctoral students, Ms. Bhavana Kulkarni, who conducted her research under the guidance of Dr Sanjeev P. Maradur, submitted her PhD thesis to MAHE and was awarded her PhD in September 2024. Ms. Asha Devi, working under the mentorship of Dr Naresh Nalajala, received the DST-Inspire fellowship.

Dr Ananda, faculty member and two doctoral students, Mr. Harsha and Ms. Meghana, received awards for best oral/poster presentations at national and international conferences. Dr R. Srikanth was invited to serve as an Expert Member on the Expert Committee of the Karnataka Science and Technology Academy (KSTA), and Dr Ganapati V. Shanbhag was honoured as a Fellow of the Royal Society of Chemistry (FRSC), London, for his contributions to chemical sciences at PPISR. During this tenure, 33 research interns from various colleges and universities carried out research with our faculty as part of their MSc projects, leading to co-authored publications. We signed two MOUs with reputed organizations namely QDit Labs and ICFRE-IWST, to foster collaborative research and scientific exchange. Several events were successfully conducted, including PPISR's Annual Day Celebration, National Science Day, Founder's Day, Chemistry Day, and an outreach program titled "Today's Science for Tomorrow's Scientists," for students of all five Poornaprajna Education Centers' in Bengaluru. Furthermore, PPISR has introduced three new certificate programs in 2024: the Poornaprajna Post-Doctoral Fellow (PPDF), the Poornaprajna Senior Research Fellow (PSRF), and the Poornaprajna Junior Research Fellow (PJRF) programs. On the whole, the year 2024 was challenging, highly productive and successful. I would like to attribute all these achievements to excellent work carried by our team faculty members, students and staff members. I also would like to express my deep gratitude to H. H. Shree Eeshapriya Theertha Swamiji and AMEF management for their continuous support, encouragement and guidance to achieve these successful milestones.

Dr. A. B. Halgeri
Former Director

Forward from Director (I/C)

I am pleased to present the Annual Report of Poornaprajna Institute of Scientific Research (PPISR) for the year 2024–25. Since assuming charge as Director In-Charge on January 7, 2025, my foremost priority has been to strengthen the institute's academic ecosystem and elevate its research profile.

Between January and March 2025, we undertook a focused drive to enhance sponsored research funding. Faculty members were actively encouraged to submit high-quality proposals to national and international agencies, with special emphasis on patent-oriented and outcome-driven projects. This initiative has led to a marked increase in proposal submissions, alongside a growing momentum in high-impact publications and product-based research efforts.

To improve operational clarity and efficiency, we have streamlined several academic policies. I also facilitated the appointment of two distinguished faculty members who returned from overseas, bringing valuable international expertise to our expanding research environment.

Enhancing the PhD program remains a central goal. We initiated discussions to renew our Memorandum of Understanding with MAHE, Manipal, and submitted the necessary documentation for DSIR renewal. In parallel, steps have been taken to increase the number of PhD fellowships, ensuring that PPISR continues to attract and retain outstanding research scholars.

This year marks a phase of transition, rejuvenation, and purposeful advancement for PPISR. I extend my heartfelt gratitude to our dedicated faculty, staff, research scholars, and collaborators for their unwavering commitment and contributions.

Dr. Ananda
Director In-Charge

MEMBERS OF BOARD OF TRUSTEES/ MANAGEMENT

H. H. Shree EeshapriyaTheertha Swamiji Peetadhipathi, Sri Admar Mutt, Udupi	Chairman
H. H. Shree Vishwapriya Theertha Swamiji Sri Admar Mutt, Udupi	Former Chairman
Dr. A. P. Bhat	Hon. Secretary
Dr. K. Srihari Professor (Rtd), UAS, Bengaluru	Former Hon. Secretary
Sri G. V. Krishna C. A.	Hon. Tresurer
Sri B.R. Prabhakara, IAS, Former Chief Secretary Govt. of Karnataka	Member
Sri Rajendra J. Hinduja, Industrialist, Bengaluru	Member
Sri Laxmisha G. Acharya, Industrialist, Mumbai	Member
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Padma Shri Dr. V.R. Prahalada, Former Vice Chancellor, Defence Institute of Advanced Technology, Pune	Member
Prof. V. Nagaraja, Professor IISc, Bengaluru	Member
Sri. Jayaprakash Mady	Member
Dr. Ananda Kulal	Director (Incharge)
Dr. Anand B. Halgeri, PPISR	Former Director
Sri. P. Sreenivasa Rao, PPISR	Former Financial Advisor
Padma Vibhushan Prof. P. Rama Rao, FASc, FNA, FNASc, Ex. Secretary, Ministry of S &T, GOI	Special Advisor
Sri K. R. Prasad, Advocate, Bengaluru	Special Advisor

RESEARCH ADVISORY COMMITTEE

1. Padma Shri Dr V R Prahalada, Former Vice Chancellor, Defense Institute of Advanced Technology, Pune
2. Prof C Sivaram, Professor, Indian Institute of Astrophysics, Bengaluru
3. Prof S Natarajan, SSCU, IISc, Bengaluru
4. Prof G U Kulkarni, Director CeNS and Professor, JNCASR, Bengaluru
5. Prof TN Guru Row,RetiredProfessor,SSCU, IISc, Bengaluru
6. Prof Chandrabhas Narayana, Director, RGCB, Thiruvananthapuram
7. Prof S Ramakumar, Retired Professor, IISc, Bengaluru
8. Prof Uday Kumar Ranga, Professor, MBGU, JNCASR, Bengaluru
9. Prof B Gopal, Professor, MBU, IISc, Bengaluru
10. Prof Jayanth Murthy, Professor, IIA, Bengaluru
11. Prof Sisir Roy, T.V. Raman Chair Visiting Professor, National Institute of Advanced Studies, Bengaluru.
12. Dr Sateesh K S, Professor, The University of Trans-Disciplinary Health Sciences and Technology, Bengaluru.
13. Prof A. B. Halgeri, Former Director, PPISR
14. Dr. Ananda Kulal, (Member Secretary), Director (I/C), PPISR

DOCTORAL ADVISORY COMMITTEE

Dr. C. Sivaram	Former Professor, Indian Institute of Astrophysics (IIA), Bengaluru
Dr. C.S. Gopinath	Visiting Professor, Indian Institute of Technology, Palakkad
Dr. C. M. Chandrashekhar	Adj. Faculty, Indian Institute of Science (IISc), Bengaluru
Dr. Dinesh Nagegowda	Sr. Principal Scientist, CSIR-CIMAP, Bengaluru
Dr. K. R. Krishnamurthy	Former Professor, Indian Institute of Technology (IIT) Madras, Chennai
Dr. Arun Basrur	Former Head R&D, Sud Chemie Ltd., Vadodara
Dr. A. Sakthivel	Professor, Central University of Kerala
Dr. Shubhangi Umbarkar	Sr. Principal Scientist, CSIR-National Chemical Laboratory (NCL), Pune
Prof. Sudarsanam Putla	Asst. Professor, Indian Institute of Technology (IIT), Hyderabad
Prof. Naveen V Kulkarni	Asst. Professor, Amrita Vishwa Vidyapeetham, Kerala
Dr. Ankur Bordoloi	Principal Scientist, CSIR-Indian Institute of Petroleum (IIP), Dehradun
Dr. Vijay Ramdin Singh	Asst. Professor, GITAM University, Bengaluru
Prof Sachin R Rondiya	Asst. Professor, Indian Institute of Science (IISc), Bengaluru
Dr. Udupi A. Ramagopal	Professor, GITAM University, Visakhapatnam
Dr. Nalini Sundaram	Vice. Dean, St. Joseph's University, Bengaluru
Dr. Suresh Kulakarni	Associate Professor, Manipal Academy of Higher Education, Manipal
Dr. Avishek Saha	Senior Scientist, Catalysis and Inorganic Chemistry Division, CSIR-National Chemical Laboratory Pune

ORGANIZATION

Director (I/C): Dr. Ananda Kulal
Hon. Tresurer: Sri. G. V. Krishna, C. A.
Former Director: Dr. Anand B. Halgeri
Former Financial Advisor: Sri P. Sreenivasa Rao

Core Faculty:

Dr. Sujit Sarkar
Dr. Srikanth R.
Dr. Ananda K.
Dr. Sanjeev P. Maradur
Dr. Naresh Nalajala
Dr. Nagasuresh Enjamuri
Dr. Shivakumar K. I

Honorary and Adjunct Professors:

1. Prof. Paniveni Udayashankar -Theoretical Sciences
2. Dr.Gurumurthy Hedge, Hon. Adjunct Professor, Materials Sciences
3. Dr.Harishkumar Madhyastha , Hon. Visiting Professor, Biological Sciences
4. Dr. Pradeep G Siddheshwar, Hon. Adjunct Professor, Theoretical Sciences.

Administration:

Senior Administrative Officer: Sri. Narayana Kulakarni (on Deputation)
Accounts Officer: Mr. Veeranna

Support staff:

Mr. Vishwaprakash A.
Mr. Praveen Kadam
Mr. Bairappa Gowda
Mr. Venkata Ramana

ABOUT THE INSTITUTE

The Poornaprajna Institute of Scientific Research (PPISR)**,** situated near the Bengaluru International Airport, stands proudly on a serene 32-acre campus envisioned as a sanctuary for scientific pursuit. The institute was conceptualized and founded by the visionary pontiff of Admar Mutt, H. H. Late Shree Vibudhesha Theertha Swamiji, whose dream was to create an environment where scientists could be inspired to conduct original and innovative research in both fundamental and applied sciences. This vision was set in motion when the foundation stone of the campus was laid in 1998 by the then Hon'ble Prime Minister of India, Shri Atal Bihari Vajpayee. Recognized by the Department of Scientific and Industrial Research (DSIR), Government of India, and by Manipal Academy of Higher Education (MAHE), Karnataka**,** as an R&D centre, PPISR today houses three vibrant departments—Theoretical Sciences, Materials Science, and Biological Sciences—each engaged in advanced, cutting-edge research. Under the leadership of the present Chairman, H. H. Shree Eeshapriya Theertha Swamiji, and with the keen guidance and interest of H. H. Shree Vishwapriya Theertha Swamiji, PPISR continues to evolve into a true Centre of Excellence, steadily realizing the noble vision of its revered founder. In just three years, significant milestones have been achieved, including the inauguration of the Biological Sciences laboratory, a modern hostel facility, and the establishment of a state-of-the-art Materials Science Laboratory, generously donated by Bharat Ratna Prof. C. N. R. Rao, at the Bidalur campus.

Today, the Institute is home to eight core faculty members, several eminent adjunct and honorary professors, and 35 distinguished scientists from premier organizations. PPISR has already produced 32 Ph.D. graduates in collaboration with MAHE, and currently nurtures 15 doctoral scholars along with several project assistants engaged in government- and industry-sponsored projects. With over 420 publications in reputed international journals (average impact factor >3.0, on par with elite institutes of the country), three international patents filed, and two US patents granted from a collaborative project with HPCL, PPISR has firmly established its global footprint. Promoted and managed by the Admar Mutt Education Foundation (AMEF)**,** PPISR belongs to a rich academic family that includes more than thirty-three Poornaprajna Schools, the Poornaprajna Institute of Management, and the Poornaprajna Institute of Faculty Improvement, all under the aegis of the Udupi Shree Admar Mutt Education Council (AMEC)**.**

These accomplishments would not have been possible without the guidance, blessings, and unwavering support of H. H. Shree Vishwapriya Theertha Swamiji, H. H. Shree Eeshapriya Theertha Swamiji, and the management of AMEF, along with the dedication of the faculty, students, and staff of PPISR. Together, they have transformed the dream of H. H. Shree Vibudhesha Theertha Swamiji into a living reality—an institution committed to advancing knowledge and serving humanity through science.

MISSION OF THE INSTITUTE

* To advance knowledge through cutting-edge research in selected frontier areas of basic and applied sciences.
* To support and promote sponsored research programs by providing state-of-the-art infrastructure and facilities.
* To foster industry collaborations for focused, application-oriented research that addresses real-world challenges.
* To publish high-quality research in reputed national and international journals of strong impact.
* To strengthen collaborative research networks with leading scientists and academic institutions across the country and abroad.
* To nurture the next generation of scholars by producing Ph.D. graduates of the highest caliber, well-prepared for competitive global careers.
* To offer research opportunities for talented young students through short-term projects and internships.
* To file patents and translate research findings into technologies with potential commercial and societal impact.
* To host visiting scholars and faculty from India and abroad, fostering intellectual exchange and collaboration.
* To organize periodic summer and winter schools that inspire and train undergraduate and graduate students.
* To provide a dynamic forum for scientific dialogue on frontier topics, benefiting PPISR scientists and the broader research community.

DIVISION STRUCTURE

Faculty	Research Scholars/ Project Students
MATERIALS SCIENCE AND CATALYSIS	
Dr. Sanjeev P. Maradur Associate Professor & HoD	Mr. Harsha H., Ms. Chaitra H., Mr. Sumit B., and Mr. Mallikarun R.
Dr. Naresh Nalajala Assistant Professor	Ms. Asha Devi K. S., Mr. Manjunath Reddy G., and Ms. Meghana H.
Dr. Nagasuresh Enjamuri Assistant Professor	Mr. Basavaraj Kumbarageri
Dr. Shivakumar K I Assistant Professor	-
Dr. A. B. Halgeri Professor and Former Director	-
BIOLOGICAL SCIENCES	
Dr. K. Ananda Associate Professor, HoD, Dean & Director (I/C)	Mr. Mallikarjun M, Ms.Akshitha PS, Ms.Deepika M
THEORETICAL SCIENCES	
Dr. Sujit Sarkar Associate Professor	Mr. Vaishnav Mallya
Dr. R. Srikanth Associate Professor & HoD	Mr.Sanjoy Dutta, Mr.Shubhodeep, Dr. Vijay Pathak

MATERIALS SCIENCE AND CATALYSIS DIVISION

The department, established in May 2010 under the leadership of Former Director Prof. A. B. Halgeri with the support of the AMEF Executive Committee, has since grown into a vibrant hub of research and innovation. Its core faculty members bring expertise from diverse fields including industrial chemistry, catalysis, polymers, and materials science. A dedicated materials synthesis laboratory equipped with advanced instrumentation has been set up, providing state-of-the-art facilities for cutting-edge research. Talented and motivated students are carefully selected through rigorous interviews and admitted to the Doctoral Programme. To date, 16 scholars have successfully earned their Ph.D. degrees, while several others are currently pursuing their research with dedication. The department has made an impressive academic impact, producing over 180 publications in reputed national and international journals with an average impact factor exceeding 4.0. Its students have also excelled at the national and international level, securing around 30 best paper presentation awards. On the research front, the faculty has successfully completed 23 government- and industry-sponsored projects, and the division continues to foster knowledge exchange by organizing conferences and workshops.

The Mission of the Division

- **To drive innovation in science and technology** by designing and developing novel multifunctional materials with applications spanning heterogeneous catalysis, photocatalysis, nanotechnology, gas sensing, adsorbents, photoluminescence, and beyond—laying a strong foundation for impactful academia–industry partnerships.
- **To nurture the next generation of researchers** by training doctoral students through a rigorous research program that fosters excellence, creativity, and independent thinking.
- **To strengthen global scientific exchange** by building collaborations with leading national and international research institutions, advancing knowledge through joint projects, training programs, and outreach initiatives.

Specific areas of research:

- Heterogeneous catalysis
- Shape selective acid-base catalysis
- Novel materials for green chemical processes
- Biomass conversion to value-added products
- Catalytic CO_2 utilization by converting into useful chemicals
- Mesoporous polymers for catalysis and other applications
- Metal organic frameworks for catalysis and gas sensing
- Gas sensing
- Pilot scale photocatalysis
- Green H_2 and Ammonia Generation
- Computational studies (DFT) for 'structure-property' correlations

Faculty Profile

Dr. A. B. Halgeri
Professor and Former Director
Email: abhalgeri@gmail.com, director@ppisr.res.in
Homepage:https://ppisr.res.in/faculty/b-halgeri/

EDUCATIONAL QUALIFICATIONS:

Master's Degree in Chemistry from Karnataka University, Dharwad Ph.D. in Physical Chemistry (Heterogeneous Catalysis) from Bangalore University Postdoctoral researcher under the UNESCO fellowship on Zeolite Catalysis at Department of Tokyo institute of Technology, Japan

AREAS OF INTEREST:

Dr. Anand B. Halgeri is served as Director of Poornaprajna Institute of Scientific Research and coordinated the entire research activity in Catalysis/ Materials science Biological sciences. His area of interest includes Nano catalysis, Heterogeneous catalysis, mesoporous materials, novel Zeolites, Solid Acid/ BaseCatalysts, Industrial Refinery/petrochemical processes, adsorption, Eco-friendly processes, and Biodiesel/Biofuel, alternate energy feed stocks etc. He has taken several industrial research projects both from India and abroad in the area of Zeolite Catalysis and Materials Science.

CURRENT ACHIEVEMENTS

Prof. Halgeri was actively involved in the industrial projects and, was responsible for getting sponsorships from the companies, such as M/s GTC Technologies in USA, HPCL R & D, and Shell Technology India Pvt Ltd. The process technology for development of catalyst process for the production of paraxylene which is raw material for polyester industry has been developed in association with GTC and is likely to be commercialized in PetroChina.

Industrial projects successfully completed under his dynamic leadership are as follows:

- Design and development of a catalyst and process for selective methylation of benzene/ toluene to produce p-xylene (Sponsored by: GTC Technology, USA)
- Post-synthesis pore engineering and surface treatment of zeolites and some oxide materials (Sponsored by: Shell Technology Centre, Bangalore)
- Development of Zeolite Modified Catalysts for the Hydrocarbon Conversions such as light naphtha aromatization and side chain alkylation of toluene. (Sponsored by: HPCL R&D Centre, Bangalore)

- "Development of a Novel Mesoporous Polymer Based Soild Acid Catalyst for Low Temperature Catalytic Applications" sponsored by HPCL (R&D)
- "Development of Novel Catalyst for light napthavolarisation" sponsored by HPCL (R&D)
- "Natural gas conversion to value-added chemicals" sponsored by to M/S. GTC Technology US LLC
- Catalyst evaluation studies for methanol reforming for fuel Cell applications (Sponsored by Thermax Industries Pune
- "Development of adsorbent materials for sulfide compounds removal" Sponsored by: GTC Vorro LLC, USA

INDUSTRIAL PROJECTS:

1. "Development of Catalyst and Process for Specific CO2 Transformation" sponsored by: Hindustan Petroleum Corporation Ltd. (HPCL)
2. Structure Based Rational Design of Pd1 Mutants to Create Lead Molecules for Cancer Immunotherapy" sponsored by: Bristol Myers Squibb, USA
3. "Design and Development Of A Catalyst And Process For Selective Methylation of Toluene To Produce Para-Xylene" sponsored by GTC Technology, USA
4. "Catalyst Process Development for Aromatics Alkylation to make higher Aromatics" sponsored by Deepak Novochem Technologies Ltd., Pune
5. "Design Development of A Catalyst Process for Regioselective Nitration of Aromatics" sponsored by Deepak Nitrite Ltd, Vadodara
6. "Rationalization of Yield Prediction Guided by Computational Insights" Sponsored by Sravathi AI Technology Pvt Ltd (SAITPL), Bengaluru
7. "Catalyst and process development for hydrocarbon synthesis via halogen mediation" Sponsored by: Sulzer-GTC Technology Inc, USA

MAJOR ACHIEVEMENTS AT PPISR:

1. During his tenure as the Director, 31 research scholars have obtained their Ph.D. degrees at PPISR
2. Successfully completed several industry-sponsored projects under his leadership
3. Under his leadership as a Chairman, several Workshops including prestigious 23nd National Symposium on Catalysis (CATSYMP-23) were successfully conducted.

PUBLICATIONS AND PATENTS

He has published around 150 research papers in national and international peer reviewed journals and has also obtained 40 Indian and International patents.

PREVIOUS R & D ACCOMPLISHMENTS IN INDUSTRY

Dr. Halgeri joined a newly established Research Centre of the Indian Petrochemicals Corporation Ltd (IPCL), Baroda – Gujarat, in 1976. As a Vice President and Head of RD Division of the Public 16 Sector Indian Petrochemicals Corporation Ltd. Baroda, Gujarat, Dr. Halgeri provided sustained leadership to the large number of scientists engaged in research and Development activities. Later, Dr. Halgeri joined the Research and Development Centre of Reliance Industries Ltd, where he led a team of 150 Scientists and Engineers and coordinated the entire research and development activities on catalysts required for the Petrochemical units and Refineries. He also provided the research support for the Polymer Science and Technology, and Materials Science groups of all the units of Reliance Industries at different locations. Before joining PPISR, Dr. Halgeri has worked extensively and achieved several milestones in the development and commercialization of catalysts for the petrochemical industry. Dr. Halgeri's contribution in the area of catalysts has helped putting India in the world map of petrochemicals. In recognition of his outstanding contribution, Dr. Halgeri has received several National awards and Honors for his achievements in Chemical Technology. Recently, he has received Lifetime Achievement Award from the Material Society India for his immense contribution in catalyst design and process development during the ICAMR-2019 conference.

Ph.D. Students Guided:

Three doctorates under his guidance are:
1. Mrs. Swetha Sandesh (Guide)
2. Mr. Vijayakumar Marakatti (Co-Guide)
3. Mr. Janardhan H L (Co-Guide)

AWARDS AND HONOURS

In recognition of his outstanding contribution in the area of heterogeneous catalysis for over three decades, he has received several National awards and Honors for his achievements in Chemical Technology.

1. I.C.I. India Ltd Award of Indian Institute of Chemical Engineers has been conferred to him for Excellence in process/Product development for para-diethyl benzene
2. Hari Om Ashram Prerit- Prof. S. S. Bhatnagar Endowment Research Award for Excellence in Applied Catalysis \
3. Lifetime Achievement Award "Eminent Scientist in Catalysis" by the Catalysis Society of India, Indian Institute of Technology, Madras
4. Elected as "Fellow of Institute of Chemical Engineer" by Indian Institute of Chemical Engineers, Kolkata
5. Vividhalaxshi Audyogik Samshodhan Vikas Kendra, Mumbai, VASVIK Industrial National Award in Chemical Sciences and Technology - 2005
6. Prof. K.G. Naik Memorial Gold Award of M.S. University, Baroda – 2007 for outstanding achievements in Chemical Sciences

7. Awarded as “Pride citizen of Baroda” for his significant contribution for Science Technology from Community Science Centre/Rotary Club of Baroda-2008
8. Life time achievement award by CSI-Bengaluru Chapter for his contribution towards Catalysis research
9. Lifetime Achievement Award from the Material Society India for his immense contribution in catalyst design and process development during the ICAMR-2019 conference.

Dr. Ganapati V. Shanbhag
Associate Professor & Former HoD & Dean
Materials Science and Catalysis Division
E-mail: shanbhag@ppisr.res.in

BRIEF CV:

- January 2023-October 2024 Dean (Academics), PPISR
- April 2019-October 2024, HoD, Materials Science and Catalysis Division
- January 2018 – October 2024, Associate Professor, PPISR, Bengaluru, India
- 2010 – 2017: Asst. Professor, PPISR, Bengaluru, India
- 2008 – 2010: Research Scientist, Dept. of Chemistry, Korea Advanced Institute of Science and technology (KAIST), South Korea
- 2002 – 2008: Ph.D. CSIR-National Chemical Laboratory, Pune India
- 2000 – 2001: Research Associate, ICI India Ltd (MNC), Mumbai, India
- 1999 – 2000: Lecturer, M.M Arts & Science College, Sirsi, India
- 1999: M.Sc. Organic Chemistry, Karnatak University, Dharwad, India

RESEARCH INTERESTS:

➢ **Designing catalysts for biofuel synthesis and biomass transformation**

Glycerol is obtained as a by-product during transesterification of vegetable oil which accounts for one tenth of every gallon of biodiesel produced. Another chemicals like furfural and terpenes are biomass derivatives. These chemicals can be converted into value added products by catalytic processes namely, acetalization, oxidation, hydrogenation, hydrogenolysis, alcoholysis esterification, transesterification etc. Hence, there is a great commercial interest to design green and chemoselective catalysts for these processes. Our group has reported KF/alumina, metal hydroxystannate, modified zeolite beta, mesoporous tin oxide, mesoporous tin phosphate, catalysts for transeterification, carbonylation, acetalization, alcoholysis, estirification reactions which published in reputed international journals *viz.* Catalysis Letters, RSC Advances, Journal of Molecular Catalysis A, Catalysis Science and Techology Journals.

➢ **Pore engineering of microporous materials for shape-selective organic transformations**

Vapor phase alkylation and disproportionation of aromatics are important reactions practiced in petrochemical industries. For these reactions, thermodynamic equilibrium mixtures of all the regioisomers are obtained with nonselective catalyst. Selectivity towards para-isomer can only be increased by the application of shape-selective catalyst.. Post synthesis modification has been carried out for zeolites by silanation, selective coking and metal/non-metal oxide impregnation. Phosphate modification was studied extensively to explore the generation of new active sites, correlation of shape selectivity with phosphate modification and several model reactions such as toluene alkylation, ethyl benzene ethylation and disproportionation and competitive reaction of meta xylene and ethyl benzene. A few papers are published in RSC Advances, Applied Catalysis A journal and Chemical Engineering Science journals.

- **Chemical fixation of CO_2 by converting into valuable chemicals.**

CO_2 activation and valorization into value-added products is an emerging area of research considering the increasing environmental concerns caused by the emission of CO_2 into atmosphere by various modes resulting in the greenhouse effect and health hazards. Designing catalysts for CO_2 fixation to produce important products like cyclic carbonate, substituted urea, cyclic urea, glycerol carbonate is challenging as the catalyst should activate CO_2 and enhance the activity & selectivity towards the essential product. Tuning the nature and number of active sites on the catalyst surface is vital for these carbonylation reactions as CO_2 and the substrate are activated by basic and acidic sites respectively. After receiving a project sponsored by VGST, GOK through CESEM grant, the design of solid acid-base bifunctional catalysts for CO_2 transformation into value added chemicals has been conducted since last few years. Several research works have been published by this group in internationally reputed journals like Chemical Engineering Journal, ACS Applied Nano Materials, Journal of CO_2 Utilization, Applied Catalysis A and a book chapter with Springer Nature publishers.

RECOGNITIONS/ACHIEVEMENTS/AWARDS/MEMBERSHIP:

1. Dr. Ganapati V. Shanbhag have been admitted as Fellow of Royal Society of Chemistry London (FRSC) on 25 September 2024.

GROUP ALUMNI:

A) PhDs

1. **Dr. Vijaykumar Marakatti:** PhD topic: Design of solid acid catalysts for Prins reaction and toluene methylation PhD from: Manipal University Date of PhD Award: 28thApril 2015 Number of Publications: 08 Number of Patents: 01 Present Position: Research Scientist, King Abdullah University of Science and Technology (KAUST), Saudi Arabia.
2. **Dr. Janardhan H L:** PhD topic: Studies on pore modified zeolite catalysts for aromatization and aromatic substitution reactions Date of PhD Award: 10th June, 2015 Number of Publications: 05 Number of Patents: 01 Present Position: Team Lead, Materials Research, Dhio Research and Engineering Pvt. Ltd, Bengaluru.
3. **Dr. Manjunathan P.** PhD Title: "Designing Heterogeneous Catalysts for the Conversion of Glycerol & Furfuryl Alcohol into Value-Added Chemicals" Date of PhD Award: 21st August, 2018 Number of Publications: 10 Award: Senior Research Fellowship 2016 (CSIR, Govt. of India) Present Position: Research Officer, Indian Oil Corporation Ltd (IOCL), Govt. of India since June 2021.
4. **Dr (Mrs). Swetha Sandesh**
   PhD topic: Novel eco-friendly catalysts for biodiesel synthesis and conversion of by-product glycerol into value-added products Date of PhD Award: 09th May 2015 Number of Publications: 06 Award: Senior Research Fellowship 2012 (CSIR, Govt. of India) Present Position: CEO, Niranthara Scientific Solutions Pvt Ltd
5. **Dr. Nagendra Kulal:** PhD topic: "Metal oxide based acid-base bifunctional catalysts for chemical fixation of $C0_2$ via carbonylation reactions"Date of PhD Award**:** December 22, 2021 Present Position: Post Doctoral researcher, Catalysis Division, Refining and Advanced Chemicals, King Fahd University of Petroleum and Minerals (KFUPM), Dhahran, Saudi Arabia.
6. **Dr. Marilyn Dmello:** PhD topic:Design and Development of Metal-Organic Frameworks based Materials for Gas Sensing Applications, Date of PhD Award**:** September 30, 2022 Present Position:SERB-National Postdoctoral Fellow, Centre for Nano and Soft Matter Sciences, Bangalore
7. **Ms. Chethana A.:** PhD topic:Design of Semiconductor Oxide Nanomaterials for Efficient Gas Sensors, Date of PhD Award**:** 6th March 2023 Present Position:Post Doctoral Fellow, Jawaharlal Nehru Centre for Advanced Scientific Research, Bengaluru

B) M. Tech Thesis Guided:
1)Mr. Satish Burla 2011-2012. Currently, he is Scientist in SABIC Research Centre, Bengaluru
2)Mr. Prashant Kumar K. 2012-2013. Currently, he is Scientist in SABIC Research Centre, Bengaluru
3)Mr. Girish Kamath 2015-2016. Currently, he is pursuing his PhD at Univ. of Saskatchewan, Canada

C) Post-Doctoral Fellows:
1) Dr. Ramesh S. 2012-2013: He worked in a project sponsored by Shell Technology Centre, Bengaluru and GTC, USA for the period of 1 year.
2) Dr. Prakash Chandra 2015-2016: He worked in the project sponsored by PW Technology Inc, USA for the period of 1 year.
3) Dr. Subba Reddy Marri 2016-2017:He conducted research in industry project sponsored by HP Green R & D Centre Bengaluru and worked during 2016-2017.

NATIONAL AND INTERNATIONAL COLLABORATORS:

1. Dr. Nikolay Nesterenko, Head, Global Solutions, Sulzer-Chemtech, Switzerland
2. Prof. Ajayan Vinu, University of Newcastle, Australia
3. Dr. Ding ZhongYi, Sulzer-GTC Technology Inc, USA
4. Dr. C. S. Gopinath, HOD, Catalysis Division, CSIR-NCL, Pune
5. Dr. G. Valavarasu, DGM, HP Green R & D Centre, Bengaluru
6. Dr. Raman Ravishankar, DGM, HP Green R & D Centre, Bengaluru
7. Prof. Shubhangi Umbarkar, Principal Scientist, CSIR-NCL, Pune.
8. Prof. Rajendra Srivastava, Associate Professor, IIT-Ropar, Punjab
9. Prof. A. Sakthivel, Central University of Kerala, Kasargod.
10. Dr. Ankur Bordoloi, Sr. Scientist, CSIR-IIP, Dehradun

RESEARCH PROJECTS (2024-2025):

1) Synthesis of fertilizers using CO_2 mineralization technique
Sponsoredby: SABIC Research and Technology Pvt. Ltd, Bengaluru 2023-2024
Duration: 1 Year and 3 months
Principal Investigator: Dr. Ganapati V Shanbhag
Co-investigator: Dr. Naresh Nalajala
Research fellows: Mr. Kaviraj, Ms. Harshitha
The project proposal by Dr. Shanbhag was accepted by SABIC on CO2 mineralization research and the project was initiated in October 2023. There was initial set up of the experiments and hiring of the project fellows. Initial synthesis work was started and the reaction conditions were optimized for two important fertilizer chemicals. Later, 1 KG bulk synthesis was conducted and high yields of the products were obtained. The products were characterized by various techniques to know the purity, moisture, particle size etc. These products were sent to SABIC for further evaluation and the report was submitted.

Status: Completed

2) Next Generation Cellulose Based NP Fertilizers

Sponsored by: SABIC Research and Technology Pvt. Ltd, Bengaluru , 2024
Duration: 3 months,
Principal Investigator: Dr. Ganapati V Shanbhag
Research fellows: Mr. Kaviraj, Ms. Harshitha, Mr. Magudeshwaran, Mr. Ganesh and Mr. Karthikeyan
A new agreement was signed with SABIC in March 2024 to initiate a project to make cellulose based NP Fertilizers. The project was initiated by procurement of chemicals and the work is going on successfully. A few project review meetings are conducted and it is on the verge of completion.

Status: Completed.

- **Publications (2024-2025):**

C. N. Mallannavar, S. Sujith, S. D. Patil, S. P. Maradur and G. V. Shanbhag "Bimetallic oxide catalysis meets silanol-enhanced synergy: A winning combination for efficient CO2 fixation by cycloaddition with styrene oxide", Molecular Catalysts 579 (2025) 115029(IF: 4.9).

B) Key Events and Achievements (2024-2025):

- ❖ Dr. Shanbhag was invited as subject expert in the interview panel for the recruitment process of a Chemistry faculty at Department of Chemistry, R V College of Engineering, Bengaluru on April 22, 2024

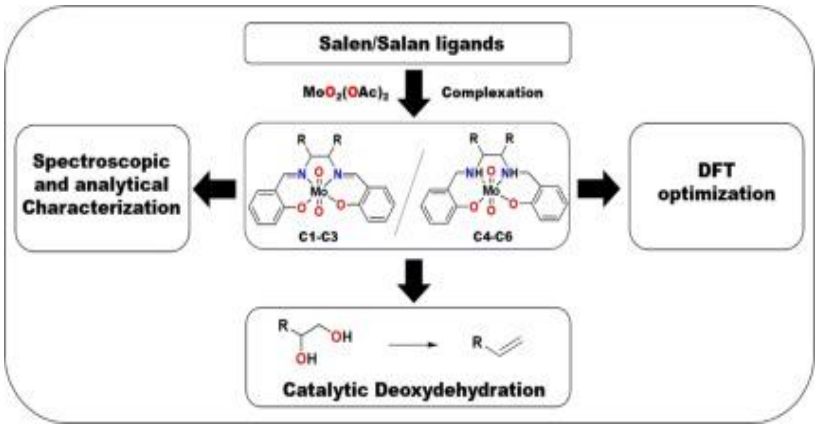
- ❖ Dr. Shanbhag was invited as synopsis evaluator for PhD synopsis of 11 students of CNMS, Jain University, Bengaluru and attended virtually on May 9, 2024.

Faculty Profile

Dr. Sanjeev P. Maradur
Associate Professor& HOD
Materials Science& Catalysis Division
*E-mail:*sanjeevpm@ppisr.res.in

RESEARCH INTERESTS:

Our research group specializes in heterogeneous catalysis. We work on biomass conversion to value added products and catalytic CO_2 conversion into value-added products as part of gas-to-liquids initiatives. We are also exploring new routes for C-H activation of methane to value added chemicals etc. We have established a state of art research facilities which includes several vapor phase reactors, high pressure batch reactor autoclaves of 50 ml to 2 lit capacity and a fully automated Pilot scale catalytic testing unit for vapor phase screening on 15 to 20 gm scale. We maintain strong industry-academia partnerships, having successfully completed eight industry-sponsored projects with partners including SABIC technology Centre Bengaluru, Deepak Nitrite Ltd. Baroda, Thermax Industries Pune, and HP Green R&D Bengaluru. Additionally, we collaborate with leading national institutes such as IISc, JNCASR, and other universities in Bangalore.



Recently we started exploring metal organic frameworks (MOF's) for catalytic applications. Metal-organic frameworks (MOFs) are the emerging porous materials that have acquired staggering attention owing to its unique properties such as high specific surface area (SSA), intrinsic porosity, and tailorable chemistry. Our group continued collaboration with IISc Bengaluru on development of hybrid catalysts for reversible hydrogen storage in liquid organic hydrogen carriers. The catalyst developmental work was done at Prof. Balaji R. Jagirdar's laboratory at IPC, IISc and catalyst screening and process developmental work was carried out at PPISR. Also, collaborations with other institutions like MAHE Manipal in the area of photocatalysis, Amritha University on deoxydehydration of polyols to olefins and REVA University Bengaluru are ongoing and fruitful.

Training of Students:

PhD Awarded	: 04
Guiding as PI	: 04
MSc Project completed	: 33
B.Tech/M. Tech. Project completed	: 07

Recognistions/Achievements:

1. Received "**Award for Best Publication**" in Metallurgical and Materials Science Category, from Vision Group on Science & Technology (VGST, Govt. of Karnataka 2019-2020).
2. Received **Seed Money for Young Scientist Research Program Award** from Vision Group on Science and Technology, Govt of Karnataka in 2014.
3. Received a **plaque from GTC Technology Inc. USA** in 2014& 2015 in recognition of the milestones achieved by the group in developing a modified zeolite catalyst for aromatics technology.
4. Co-inventor in 2 Korean patents on a). Preparation of novel mesoporous polymer and b). Low-cost carbon-fiber technology with two different research groups of South Korea.
5. Life member of Catalysis Society of India (CSI).

STUDENTS

Alumni:

1. Dr Manjunathan P. (Co-guide)
2. Dr Sathyapal R. Churiparad (Guide)
3. Dr. Kempanna S. Kankikodi (Guide)
4. Dr. Bhavana B. Kulkarni (Guide)

PhD Students (Ongoing)

1. Mr. Harsha M.
2. Ms. Chaitra M.
3. Mr. Sumit B. Bubanale
4. Mr. Mallikarjun Ranjanagi

Proposals Submitted:

1. Naphtha processing in vapor phase in fixed bed to improve its RON typical operating conditions: Temp. 500°C max. and Pr. 7kg/cm2g max.

Principal Investigator: Dr. Sanjeev P. Maradur, **Co-PI**: Dr. Nagasuresh

Introduction: A research proposal has been submitted to Chemdist and Excel tech Pune to work on design and develop transition metal supported ZSM-5 catalysts by PPISR for naphtha processing in vapor phase to improve its Research Octane Number (RON). For three months short term project extendable upto another three months depending on the remaining work. A detailed proposal with work

plan has been sent and couple of meetings has been done to look the feasibility of undertaking this work.

Status of the project: Scientist team from Chemdist and Excel tech Pune are visiting PPISR Campus in the 1st week of October for the final discussion meeting. The project is kept on a hold from customer side.

2: Development of titanosilicate based zeolite catalysts for the epoxidation of linear alpha olefins using hydrogen peroxide

Principal Investigator: Dr. Nagasuresh, **Co-PI**: Dr. Sanjeev P. Maradur

Introduction: A research proposal has been submitted to M/s Jeevan Chemicals To design and develop titanosilicate based (TS-1, HTS-1 and Ti-MWW) zeolite catalysts and process for the epoxidation of linear alpha olefins (C6, C8, C10 and C12) using aqueous hydrogen peroxide. The aim of the project is to achieve the targeted performance of 30-50% conversion and >95% epoxide selectivity, to enhance the catalytic performance for the epoxidation of linear alpha olefins by suitable modification to TS-1 catalyst, to study an effect of impurities in catalyst on conversion and selectivity and also, we need to scale-up of the best TS-1 zeolite catalyst-100g.

Status of the project: The project proposal has been submitted. We are in talks with them for a possible finding. Scientists from Jeevan Chemicals have agreed to visit PPISR for the final round of discussions but got delayed.

RESEARCH:

Industry Sponsored Project: "Synthesis of sulfates and carbonates from phosphogypsum and silicates via carbon dioxide mineralization" Sponsored by Sabic Technology Centre, Bengaluru Jan 2024 to Dec 2024.

Principal Investigator: PI: Dr. Sanjeev P. Maradur, Co-PI: Dr. Nagasuresh E.
Research Students: Magudeshwaran, Karthick, Kaviraj, Harshita
Aim of the project is carbon dioxide capture and utilization to produce value-added chemicals utilizing phosphogypsum which is a waste product of the phosphate fertilizer industry that is generated during the production of phosphoric acid and silicate from steel slag.

Status: Completed successfully.

ACADEMIC PROJECTS

1. **Tandem hydrogenation/hydrogenolysis of furfural to 2-methylfuran over multifunctional metallic Cu nanoparticles supported ZIF-8 catalystPrincipal**

   Principal Investigator: Dr. Sanjeev P. Maradur
   Research Student: **Bhavana B. Kulkarni**.

The hydro-deoxygenation of furfural to 2-methylfuran (2-MF) by catalytic transfer hydrogenation (CTH) is a selective route to remove the excess oxygen containing functional groups in the biomass-derived feedstocks. CTH reaction involves the use of alcohols as hydrogen donor source instead of high-pressure exogenous hydrogen, thus making the process highly economic and inexpensive. The 2-methylfuran obtained by the selective hydro-deoxygenation of furfural is an important organic chemical intermediate, as widely used in medicines, pesticides, and fine chemicals. In addition, the oxygenation-containing 2-MF has good combustion performance, high energy density, and high-octane number, is a very competitive biomass-derived gasoline alternative fuel. The reaction scheme involves hydrogenation of furfural to furfuryl alcohol which on subsequent hydrogenolysis produces 2-MF. Even though numerous studies have been reported on the conversion of furfural to 2-MF, very few catalysts have been developed for the CTH of furfural. To the best of our knowledge, there are no reports available on the MOF catalysed CTH of furfural. Herein, Cu NPs@ZIF-8 material has been synthesized and used in the CTH of furfural. The major findings of the projecthas been published in Bioresource Technology Journal (2024).

Status: Completed

2. Mil-101 (Cr)-catalysed carboxymethylation of biomass-derived alcohols to organic carbonates

Principal Investigator: Dr. Sanjeev P. Maradur
Research Student: **Bhavana B. K. and Sai Krishna**

Organic carbonates are significant intermediates in the chemical industry. They have been drawing increasing interest for various applications, as monomers for poly-carbonates and phosgene-free polyurethanes, as organic solvents, and manufacture of lithium batteries. The traditional processes for the synthesis of organic carbonates endure from limitations and still need the use of toxic reagents, like phosgene, dimethyl sulfate, carbon monoxide, and pyridine. On the other hand, Dimethyl carbonate (DMC) is an organic compound of concern owing to its extensive green credentials. It is biodegradable, non-toxic, and considered to be a green solvent. Thus, DMC is a green alternative to highly toxic and hazardous chemicals like halohydrocarbons and dimethyl sulfate in methylation reactions and phosgene in carboxymethylation reactions. DMC undergoes carboxymethylation with various alcohols to yield alkyl methyl carbonates or dialkyl carbonates without generating inorganic salts as the by-product.The major findings of the project have been published in Industrial and Engineering Chemistry Research (2024).

Status: Completed

3. Synthesis, Structural Characterization, and DFT Study of Salen-and Salan-Based Dioxomolybdenum Complexes: Catalytic Application in Deoxydehydration Reactions

Collaborators: Dr Sanjeev P. Maradur, Dr. Naveen Kulkarni (Amritha University)
Students: Bhavana. B. Kulkarni, Sumit Bubanale and Nakul (Amritha University)
Biomass deoxygenation and up-conversion have gained popularity as methods to produce commodity chemicals currently produced by the petrochemical industry. Deoxydehydration (DODH) is a promising route for converting biomass-derived diols and polyols into alkenes and dienes. The reaction converts vicinal diols into alkenes, typically using high oxidation state metal-

oxo complexes as catalysts and PPh_3 or secondary alcohols as reductants. DODH was first reported by Cook and Andrews. Cp^*ReO_3 was used as a precatalyst to convert 1-phenyl-1,2-ethanediol to styrene with PPh_3 as an oxo-acceptor and reductant. Toste and co-workers have demonstrated that $MeReO_3$ is an excellent catalyst using secondary alcohols as reductants. Other studies in the literature have shown that a wide variety of reductants can be used. Mechanistic studies of $MeReO_3$ by Abu-Omar and co-workers show that a reduced dioxo species is the active form of the catalyst. Recently, a handful of molybdenum complexes have been shown to be active for DODH at high temperatures and pressures. In this collaborative project, a series of 6 di-oxo molybdenum complexes were synthesized by Dr. Kulkarni's group and initial catalytic screening has be carried out at PPISR. Initial catalyst screening for the DODH reaction of 1,2-octane diol are promising with good selectivity for the olefin product. The NSMo3 and NSMo7 catalyst are found to be more active compared to other complexes in a series. The major findings of the project have been published in Journal Molecular Structure (2025).

Status: Completed

4. **Liquid Hydrogen Carriers: Selective Dehydrogenation of methyl Cyclohexane to toluene to produce hydrogen**.
   Collaborators: Dr Sanjeev P. Maradur PPISR & Dr Balaji R. Jagidhar, IPC, IISc Bengaluru
   Students: Sumit B. Bubanale, Ms. Jyothi Jangir, IISc

The dehydrogenation of methylcyclohexane (MCH) is a reversible reaction in which MCH is dehydrogenated to toluene and hydrogen in the forward reaction while toluene is hydrogenated in the reverse reaction. The dehydrogenation–hydrogenation of MCH–toluene system is an important reaction system in the reforming of naphtha and in hydrogen storage applications as in the methylcyclohexane–toluene-hydrogen (MTH) system. We have initiated the vapor phase catalyst screening for the dehydrogenation of methyl cyclohexane to produce toluene and hydrogen. Further catalyst screening experiments are under progress.

Status: Ongoing

5. **Selective air oxidation of the 5-hydroxymethylfurfural to 2,5- diformyl furan over MOF derived MnFe based catalyst.**
   Principal Investigator: Dr. Sanjeev P. Maradur
   Research Student: Mr. Sumit B. Bubanale

5-Hydroxymethylfurfural (HMF), a dehydration product of C6-based carbohydrates, is one of the most promising platform chemicals. HMF can be used as a versatile precursor for producing a wide range of fine chemicals, plastics, pharmaceuticals, and liquid fuels. The selective oxidation of HMF in biorefineries is a critical transformation, leading to valuable products like 2,5-diformylfuran (DFF) and 2,5-furandicarboxylic acid (FDCA). These transformations add value to biomass-derived compounds and contribute to the sustainability of chemical production processes. DFF is an important intermediate in organic synthesis, used in the manufacture of polymers, pharmaceuticals, and agrochemicals. However, DFF is expensive and available only in limited quantities due to the lack of efficient production methods. To address this, many catalysts, including noble metals, non-noble metals, and metal-free homogeneous and heterogeneous catalysts, have been explored for the transformation of

HMF to DFF. Current research aims to develop inexpensive metal-based catalysts to facilitate the efficient and selective conversion of HMF to DFF, thereby reducing costs and increasing availability.

Status: Ongoing

6. Carbonylation of amine to synthesize carbamates

Principal Investigator: Dr. Sanjeev P. Maradur
Research Student: Mr. Harsha M

Methyl N-phenyl carbamate (MPC) is a monomer for the preparation of polymeric materials such as polyurethanes and polyurea's. These materials are widely used in various applications including coatings, adhesives, sealants, and elastomers due to their excellent mechanical properties, chemical resistance, versatility and known for their biodegradability, low-level odor, high dipole moment, low toxicity, high flask and boiling points makes them as benign solvents. MPC is an important chemical produced through one-pot synthesis of aniline using urea and methanol, oxidative carbonylation of aniline, reductive carbonylation of nitrobenzene, alcoholysis of 1,3-diphenyl urea, methoxy carboxylation of aniline and the reaction of aniline with methylcarbamate. We have chosen the carbonylation route using aniline and dimethyl carbonate (DMC) for synthesis of MPC. Following many catalyst screenings, Bi_2O_3 (cubic crystal system defined by ICDD-96-210-0845) was found to be the most effective catalyst for this reaction. The activation of the N-H bond of aniline by the nucleophilic nitrogen attacking the carbonyl carbon of DMC to generate N-C coupling is an important step for the formation of MPC. Bi_2O_3 as a single metal oxide was designed using a simple precipitation method and to date there are no reports using this Bi_2O_3 single metal oxide and gave 94% conversion towards aniline and 94% yield of MPC.

Status: Ongoing

7. Transesterification of propylene glycol to propylene carbonate using DMC

Principal Investigator: Dr. Sanjeev P. Maradur
Research Student: Mr. Harsha M

Propylene carbonate (PC) is commonly employed as a polar, aprotic solvent in organic synthesis, cosmetics, gas separation, battery electrolytes, and metal extraction. Several reaction routes have been reported for the synthesis of PC, including the phosgenation of 1,2-propylene glycol (PG) with phosgene, transesterification of alkyl carbonate with PG, the reaction of carbon dioxide with o-chloropropanol, the cycloaddition of propylene oxide with carbon dioxide, and the alcoholysis of urea with PG. The reaction was carried out in a 25 mL seal tube with 0.2 g PG and 0.47 g DMC (1:2) at 120°C for 5 hours with 1 Wt.% catalyst. The catalyst was determined to be ZIF-8 (MOF). The influence of reaction temperature was investigated, and 120°C was determined to be the best reaction temperature. The reaction yield of >95% PC. Leaching investigations for the first hour revealed no leaching. The reaction showed greater activity in Zn2+ based MOF with no leaching, supporting the catalyst heterogeneity.

Status: Ongoing

8. Enhancing activity of HAP catalyst by hydrothermal in-situ Zn incorporation for transformation of CO2 to produce cyclic urea from diamines

Principal Investigator: Dr. Sanjeev P. Maradur
Research student: Chaitra N. Mallannavar

The synthesis of 2-imidazolidinone using a nontoxic CO_2 as carbonyl source has drawn greater attention as carbon dioxide is abundant, which can be used as C1 feedstock for chemical synthesis. During this period, different concentration of zinc oxide loaded Hydroxyapatite (HAP) catalysts have been screened and 13% Zn-HAP showed 60% conversion for ethylene diamine and 96% selectivity for 2-imidazolidinone. Different catalyst characterizations such as XRD, N_2-sorption, CO_2 and NH_3-TPD, SEM and XPS has done to study about the active species. Design of experiments was employed using response surface methodology to optimize reaction conditions. With the help of central composite model(CCD) reaction conditions are designed and carried out the reaction. Under optimized condition 13% Zn-HAP showed 81.5% conversion for ethylene diamine and 98.9% selectivity for 2-imidazolidinone at 140°C temperature and 17.5 bar pressure in 10 hours reaction time.

Status of the work: Manuscript under preparation

RESEARCH HIGHLIGHTS: (2024-25)

A. Publications

1. B. B. Kulkarni; V. S. K. Reddy; S. P. Maradur "Upgrading of bio-derived alcohols: Selective synthesis of organic carbonates over acid-modulated MIL-101(Cr) MOF catalyst" Authors:, Industrial & Engineering Chemistry Research, 63 (2024) 9761-9771 (IF: 3.9)

2. B. B. Kulkarni, S. P. Maradur "Tandem hydrogenation/hydrogenolysis of furfural to 2-methylfuran over multifunctional metallic Cu nanoparticles supported ZIF-8 catalyst", Bioresource Technology, 402 (2024) 130805. (IF: 9.0)

3. K. S. Choudhari, R. Sai, K. S. Kanakikodi, S. P. Maradur, S. D. Kulkarni "Co2+-laddered heterojunction a next-generation solar-photocatalyst: Unusually improved activity for the decomposition of pharmaceuticals, dyes, and microplastics" AD Lopis, , Materials Research Bulletin 176, (2024) 112836 (IF: 5.7)

4. A. Shetty, D. Sunil, T. Rujiralai, S. P. Maradur, AN Alodhayb, G Hegde "Sustainable carbonaceous nanomaterial supported palladium as an efficient ligand-free heterogeneouscatalyst for Suzuki–Miyaura coupling" Nanoscale Advances 6 (2024), 2516-2526 (IF: 4.6)

5. A. D. Lopis, K. S. Choudhari, B. B Kulkarni, S. P. Maradur, S. D. Kulkarni "pH independent adsorption: Reusable zinc-ferrite nanospheres for the selective recovery of dyes from binary mixtures", Journal of Water Process Engineering 66 (2024) 106013(IF: 6.7).

6. K. Pallavi, B. Sumit, S. Sandip, M. Sanjeev, A. Supale "Synthesis of tetrahydrobenzo[b]pyran derivatives using a novel zirconia supported sodium hexamolybdochromate(III) catalyst", Reaction Kinetics, Mechanisms and Catalysis 138 (2024) 873-888(IF: 1.7).

7. K. Menon, A. D. Lopis, K. S. Choudhari, B. Kulkarni, S. Maradur, S. D Kulkarni "Scavenger-free solar photocatalytic degradation of Textile Dyes and Antibiotics using magnetically separable bi-junctional photocatalyst", Materials Research Bulletin 181 (2025) 113074 (IF: 5.7).

8. C. N. Mallannavar, S. Sujith, S. D. Patil, S. P. Maradur and G. V. Shanbhag "Bimetallic oxide catalysis meets silanol-enhanced synergy: A winning combination for efficient CO2 fixation by cycloaddition with styrene oxide", Molecular Catalysts 579 (2025) 115029(IF: 4.9).

9. K. Kalidasan, S. Mallapur, B. B Kulkarni, S. P Maradur, D. Kumar, R Deeksha, S. Kandaiah, P. Vishwa, S. G. Kumar "Gadolinium modified g-C3N4 for S-Scheme heterojunction with monoclinic-WO3: Insights from DFT studies and related charge carrier dynamics", Journal of Materials Science & Technology 204 (2025) 166-176 (IF: 14.3).

10. A. D. Lopis, K. Menon, K. S. Choudhari, B. Kulkarni, S. P. Maradur, S. D. Kulkarni "Solar-driven plasmon-enhanced photocatalysis: Co 2+-doped ZnFe 2 O 4 nanospheres-embedded ZnO nanosheets for effective degradation of dyes and antibiotics", Nanoscale Advances 7 (2025) 1727-1735 (IF: 4.6).

B. Resource person/papers presented in conferences:

1. Dr. Maradur gave an invited talk on "Metal-Organic Frameworks (MOFs) Catalysis for Valorization of Biomass-Derived Chemicals" on 25th September 2024 at the Five days Faculty Development Program On "Green Technologies towards Sustainable Future Science and Technology" at Ramaiah Institute of Technology Bengaluru.

Other Scientific Activities

2. **Submission of Ms. Bhavana's PhD Thesis:**
   Ms. Bhavana completed her PhD work and we finalized the thesis during the said period and submitted it to MAHE on 29th April 2024. During her PhD tenure she has published 4 First author publications, One book chapter and 5 co-author publications to her credit. Also she was actively involved in PAC activities along with her research assignment.
3. **Discussions with Dr. ZhongYi on MOF materials for separation of ethane from ethylene:** we have initiated discussions with Dr ZhongYi for any possible project funding in near future. In this concern, we had series of discussions on various possible projects. Dr Maradur **c**arried out literature survey on the subject and made a presentation during meeting with Dr. ZhongYi. But the facility of adsorption setup has to be created in order to generate initial data. Funding issue is there at this moment and it is on a hold.
4. **Training of Poornaprajna High School students from Sadashiva Nagar**
   Three students from PP School Sadashiva Nagar had come for a week-long research orientation program. Dr. Maradur coordinated the event and successfully completed.
5. **Open defense of Ms. Bhavana's PhD Thesis:**Ms. Bhavana completed her PhD open Defense on 23rd September 2024. Dr Kalpana Maheria, SVNIT Surat, Dr. Nitin Kumar Shetty, MAHE were present during the defense viva. She has been awarded PhD on 25th September 2024.
6. A research collaboration with Prof. Balaji Jagidhar, IPC, Indian Institute of Science, Bengaluru as been initiated by Dr. Maradur's group during September 2024 to work on vapor phase catalysis screening. Catalyst will be synthesized at IISc and catalyst screening will be done at PPISR.
7. 3rd DAC meeting of Mr. Harsha M was held on 24th December 2024 through online google meeting. The DAC members Dr. A Skativeil, Central Univerisity of Kerala, Dr. Arun Basrur, Ex-SABIC Scientist, Dr. Ananda, PhD Coordinator, Dr Sanjeev P. Maradur, PhD Guide and other faculties from Materials Science and Catalysis Division were present during the meeting.
8. Mr. Harsha M. attended the international Conference on Carbon Capture and Utilization (ICCCU-24), December 9th to 13th, 2024 JNCASR, Bangalore.
9. Dr. Maradur coordinated the annual Outreach program for Poornaprajna High School Bengaluru students 2024 during the November 11-15th, 2024.More than 400 students attended the program.
10. Pre-DAC meeting of Mr. Sumit B was held on 24th January 2025was conducted through online google meet. The DAC members Dr. SudarsanamPutla, IIT-Hyderabad, Dr. Suresh Babu K, Central Tribal university Vijayanagaram AP, Dr. Ananda, PhD Coordinator, Dr Sanjeev P. Maradur, PhD Guide and other faculties

from Materials Science and Catalysis Division were present during the meeting.

11. 5th DAC meeting of Ms. Chaitra M was conducted on 21st January 2025was conducted online through google meet. The DAC members Dr. RajappanVetriveil, PPISR Bengaluru, Dr. C S Gopinath, NCL Pune and Dr. Ankur Bordoloi, IIP- Dehradun, Dr. Ananda, PhD Coordinator, Dr Sanjeev P. Maradur, PhD Guide and other faculties from Materials Science and Catalysis Division were present during the meeting.
12. Mr. Sumit gave an Oral presentation titled "Selective oxidation of HMF to DFF using MOF derived magnetic manganese oxide nanoparticle." At the National Conference on Next-Generation and Emerging Materials held at St. Joseph's University, Bengaluru during 27-28th February 2025.
13. Ms. Chaitra M gave oral presentation in the CSI's National conference CATSYMP-24 (Catalysis for Sustainable Chemicals, Materials & Energy (CSCME-2025)) held at Thapar Institute of Engineering & Technology Bhadson Road, Patiala, Punjab from 24-26 February 2025 on the research work "Enhancing activity of H AP catalyst by hydrothermal in-situ Zn incorporation for transformation of CO2 to produce cyclic urea from diamine" and received the "**Best Oral Presentation**" award.
14. Mr. Harsha M gave oral presentation in the CSI's National conference CATSYMP-24 (Catalysis for Sustainable Chemicals, Materials & Energy (CSCME-2025)) held at Thapar Institute of Engineering & Technology Bhadson Road, Patiala, Punjab from 24-26 February 2025.
15. Ms. Vidhyashree, Final Year MSc Analytical Chemistry student of Department of Chemistry Gitam University Bengaluru worked under Dr. Maradur as Project Intern from 3rd February to 15th March 2025.
16. Dr. Maradur continued to work in collaboration with Dr. Divakar, Faculty of Mechanical Engineering, Jahawarlal Nehru Center for Advanced Scientific Research (JNCASR), Bengaluru on developing the MOF based extrudates for oxygen adsorption applications.
17. Dr. Maradur as PI and Dr Nagasuresh as Co-PI submitted a research proposal titled "Design and Development of Catalyst and Process for the C-H Activation of Methane to Acetic Acid via Carbon dioxide Fixationunder Climate, Energy and Sustainable Technology (CEST) Division and Call for Proposals on Methane Monitoring and Mitigation Technologies DST Govt of India March 2025.

Dr. Naresh Nalajala
Assistant Professor
Materials Science & Catalysis Division
E-mail: naresh@ppisr.res.in

BRIEF CV:

- Assistant Professor, Department of Materials Science and Catalysis, PPISR Bangalore, India (01/07/2022 –To date).
- Pool Scientist, Catalysis division, CSIR-National Chemical Laboratory Pune, India (01/09/2020– 17/06/2022).
- Project Scientist, Catalysis division, CSIR-National Chemical Laboratory Pune, India (28/01/2019 – 31/03/2020).
- National Postdocoral Fellow (NPDF) at Catalysis division, CSIR-National Chemical Laboratory Pune, India (23/01/2017 – 22/01/2019).
- Research Associate (RA) at Catalysis division, CSIR-National Chemical Laboratory Pune, India (25/05/2016 – 24/11/2016).
- Research Associate (RA) at Department of Energy Science and Engineering, IIT Bombay, India (18/09/2015 – 17/03/2016).
- Ph. D. in Nanomaterials for energy-conversion applications from IIT Bombay – Monash Research Academy, during 2010-2016.
- M-Tech in Materials Science and Engineering from NIT Tiruchirapalli, Tamilnadu, during 2008-2010.
- MSc in Physics from Andhra University affiliated PG college, Andhrapradesh, during 2004-2006.

RESEARCH INTERESTS:

- **Exploring structural properties of metal oxide/metal hybrids for sensor and energy-conversion applications**

  In general, well-defined single crystal surfaces are model systems which known to exhibit surface sensitive catalytic, electrocatalytic and photocatalytic properties and efforts are therefore made to translate the findings to bulk nanomaterials of practical importance. SHAPECAT is aiming at design and synthesis aspects of nanocrystals of different shapes of various metals (Pd, Pt, Ag, Au, Cu) and semiconductors (TiO_2 , $BiVO_4$) of high selectivity in size, shape and composition. Further, the reagents used for the synthesis of size- and shape-controlled nanoparticles adsorb strongly on the surface and they adversely impact the surface properties. In this regard, surfactant removal from the shape-controlled nanoparticles is inevitable to study catalytic and electrocatalytic reactions. SHAPECAT is addressing on how to clean the nanoparticle surfaces by employing various methods such as solution phase methods, physical methods etc. In addition, SHAPECAT is interested in exploring the facet-engineered and well- integrated hybrid nanocrystals (Semiconductor (oxide based)/Metal) for sensor, catalytic, electro/ photocatalytic applications.

- **Rooftop photocatalyst panels for solar fuels and chemicals synthesis**

For instance, H_2 production from the particulate form of photocatalyst is hindered by several limitations; (a) decrease the efficiency to half when increase the loading to double due to inadequate material exposure to light, (b) prevalent light scattering rather than light absorption and therefore decrease in charge generation, (c) material disintegration due to mechanical forces which are persistent from the stirring, and (d) heavy material and infrastructure requirements which further increase the cost of hydrogen production. These issues can be successfully circumvented by taking the powder form of catalyst into thin film over a ordinary substrate. This approach is the inspiration from a leaf where all the components interconnected towards never ending photosynthesis process. In contrast to solar cell where electrons are needed to travel several microns distance to reach the contact, thin film photocatalysis provide the charge carriers locally and instantaneously utilize the charge carriers and complete the reaction that led to efficient hydrogen production. Not only aiming at the design of novel materials, SHAPECAT will be exploring on the design possibilities of photocatalyst panels with features of efficient and cost viable manner for synthesis of valuable chemicals (methanol, ammonia, ethanol) and fuels (H_2) using inexhaustible resources (Water, CO_2, N_2, CH_4 and sunlight).

RECOGNITIONS/ACHIEVEMENTS/AWARDS/MEMBERSHIP:

- Became life member of Catalysis Society of India, Bangalore Chapter.

STUDENTS (2024-2025):

	PhD students	**Intern Students (MSc Project)**
1	Ms. Asha Devi K S	1. Ms. Sarita V H
2	Mr. Manjunath Reddy G	2. Ms. Jaya K H
3	Ms. Meghana	3. Ms. Raghavi M
		4. Ms. Arpita K
		5. Ms. Hana Fathima Keloth

NATIONAL AND INTERNATIONAL COLLABORATORS:

1. Dr. K Prabhakar Reddy, Brookhaven National Laboratory, USA
2. Prof. Gurumurthy, Department of Physics, MAHE, Manipal.
3. Prof. K. Suresh K, Associate Professor, Department of Chemistry, Central Tribal University of AP.
4. Dr. Sachin Rondiya, Assistant Professor, Department of Materials Engineering, IISc Bangalore.
5. Dr. Avishek Saha, Senior Scientist, Catalysis and Inorganic Chemistry Division, CSIR-NCL Pune
6. Prof. C. S. Gopinath, Visiting Professor, Department of Chemistry, IIT Palakkad.

A. RESEARCH 2024-2025:

CURRENT FUNDING:

1. Design and development of UV-visible light active rooftop photocatalyst panels forgreen H_2 generation and value added chemicals from sunlight harvesting (Role: Principle investigator; budget: INR 29 Laks duration: 24 months; status: Ongoing). (Startup Research Grant (SRG-SERB), 2023-25).
2. Shape-engineered nanocrystals for solar H_2 and valuable chemicals from sunlights harvesting (Role: Mentor, DST-Inspire Doctoral Fellowship for Ms. Asha Devi, duration: 2023-2028). Status: Ongoing

3. Semiconductor Oxide-Crystalline Framework Hybrid Gas Sensors: Advancing Hydrogen Detection Across a Wide Dynamic Range (Role: Co-Principle investigator; budget: INR 35 Laks duration: 36 months; status: Ongoing). (BRNS, 2024-2027)

CURRENT PROJECTS:

1. Unraveling the phase engineering of TiO_2 for H_2 gas sensing applications

Principle Investigator: Dr. Naresh Nalajala
Research Student: Ms. Asha Devi
Hydrogen is becoming increasingly important in light of the world's growing energy needs due to its efficiency and environmental friendliness. However, because of its flammability, there are safety concerns, and necessitates early detection at various ppm levels (from ppb to 10%) at ambient temperatures. The present study investigated the phase engineering of TiO_2 for H_2 gas sensing behavior; to establish this, TiO_2 sensors with different phases (pure anatase, pure rutile, bi-phase (anatase and rutile), and tri-phase (anatase, rutile, and brokite)) and their Pd-modified counterparts opted. It is interesting to observe that, at room temperature (25ºC), the TiO_2 sensor with pure anatase phase (A=100) is more active (better response time and % response) compared to the sensor with the dominant rutile phase (A-0). On the other hand, at 25ºC, the A-0 sensor exhibited the best performance (response time and % response) among the others after Pd sensitization, emphasizing the importance of synergy between crystalline phases of support (TiO_2) with metal (Pd) and thus underscores the strong metal support interaction (SMSI). The present investigation on phase engineering of TiO_2 sensors unveils new scientific knowledge to design and develop efficient and stable sensors that work under ambient (preferably 25-100ºC) temperatures and a wide range of analyte concentration conditions.

Status: Manuscript under review

2. Shape-engineered nanohybrids for solar H_2 and value added Chemicals
Principle Investigator: Dr. Naresh Nalajala
Research Student: Ms. Asha Devi
This work investigate the synergestic effect between the semiconductor and metal facets for generation of H_2 and valuable chemicals synthesis. To establish, study employed water/glycerol as reactant mixture and TiO_2 (different shapes) and Pd (different shapes) as catalyst system. Glycerol known to be waste from biodiesel industry (10 % of biodiesel) and therefore it is imperative to generate value addition to waste. The aforementioned shape-engineered Pd/TiO_2 nanohybrids expect the efficient H_2 generation and value added chemicals (glycerolaldyhyde, dihydroxyacetone etc) with high selectivity and stability. The unique features of proposed nanohybrids including unsaturated surfaces, defects, O2 vacancies and active sites may pave the way for better performance.

Status: Manuscript under preparation

3. Designing photocatalyst panel reactor for small scale generation of H_2 under in-house solar simulator
Principle Investigator: Dr. Naresh Nalajala
Research Student: Mr. Manjunath Reddy

In order to translate the lab scale discoveries to commercial scale, it is important to use thinfim based catalyst materials for optimization. We have developed a portable cell of size 5x5 cm2 reactor with two acrylic substrates coated with catalyst and used silicon gasket to provide a gap between the plates. Different thickness of silicon gasket provide the thickness of reactant (for instance, water/methanol mixture) and its effect on yield of H_2. Similarly, flow rate of reactant, thickness of catalyst coating over substrate, amount of Pd over TiO_2, intensity of simulated sunlight (50, 75, 100 $mWcm^{-2}$) will be studied. The optimized performance conditions will be a guideline for our 1 m^2 pilot scale plant to generate efficient, stable and large scale H_2 production.

Status: Under progress

4. Design and development of single atom copper on TiO_2 for photo-catalytic hydrogen production.

Research Student: Mr. Manjunath Reddy

Principle Investigator: Dr. Naresh Nalajala

Hydrogen is seen as a significant energy source for the future because of its high energy content and lack of harmful or greenhouse gas emissions during combustion.Although the technology for producing hydrogen from fossil fuels is now well-established, the usage of these raw materials is unattractive for the future since they are non-renewable and release greenhouse gasses (carbon dioxide, carbon monoxide) when used to provide the energy needed for the processes involved in producing hydrogen. Titanium dioxide is the most prominent material for the photo catalytic water splitting since it has unique properties such as strong oxidising ability, long term stability, nontoxicity, high refractive index, high dielectric constant, cost effective and easy to prepare. Although titanium is good catalyst for production hydrogen to enhance its efficiency single atom copper is doped on its surface which effectively separate the electron-hole pairs, lowers the probability of a recombination process and increase light absorption to the visible portion of the solar spectrum.

Status: Manuscript under Preparation

5. Hydrolysis of furfuryl alcohol to levulinic acid

Levulinic Acid (LA)/4-oxopentanoic acid is an important chemical building block synthesized from biomass. It is known that LA is a versatile molecule due to presence of an active α-hydrogen, a reactive carboxylic acid group and a keto carbonyl group which are imperativefor synthesis of a wide array of other organic compounds. LA can either be synthesized through C_5 or C_6 sugar routes. Commercially, it is synthesized through the cellulose (C_6 sugar) route using a homogeneous acid catalyst. This method, although yields high amounts of LA, suffers from separation issues, corrosion of the reactors and environmental pollution. Also, going by the cellulosic route, would mean that it would compete with edible food sources as cellulose is a derivative of first-generation biomass. Hence, synthesizing LA via the hemi-cellulosic route is a more viable process. The best way to address this problem is by designing an environmentally friendly heterogeneous catalyst which can produce good yields of LA under mild conditions. Levulinic acid can be produced via. hydrolysis of furfuryl alcohol. However, this is a challenging reaction as it involves the opening of the furan ring and hence it demands a strong acidic catalyst. So far, only a few papers have reported the successful synthesis of LA.

Research Student: Ms. Meghana

Principle Investigator: Dr. Naresh Nalajala

B) Events and Achievements (2024-2025):

- As a seminar coordinator, more than 20 talks being conducted by in-house and external expert speakers.
- Ms. Ashadevi Ph. D. protocol presentation approved by MAHE expert committee on Apr 12, 2024.

- Ms. AshaDevi presented a poster based on TiO_2 phase engineering for H_2 gas sensing applications at a national conference on sensing and technologies at Toshali Sands Puri.
- Ms. AshaDevi gave a oral presentation based on TiO_2 phase engineering for H2 gas sensing applications at the National Conference on Condensed Matter Physics and Application 2024 at Manipal on Dec 13-14, 2024 and won Best oral presentation.
- Ms. Meghana presented her research work at the Catalysis conference organized by Thapar University, Punjab.
- My student Mr. Manjunath Reddy G presented his work on "Pilot-Scale Photocatalytic Reactor Studies for Efficient Hydrogen production: Bridging the Gap Between Lab-Scale and Industrial Applications at national conference on the Chemical Sciences for a Sustainable Tomorrow: Synergy and Solutions (CSSTSS-2025)" Organized by the Department of Chemistry, School of Chemical Sciences, St Joseph's University, Bengaluru.
- Received recognization as reviewer from the prestigious journal Angewandte Chemi International Edition of IF:16 by Wiley Publishers which is highly respected and reputed journal across the interdisciplinary sciences.
- Visited Sabic Research center for a meeting with Dr. Ravi Hegde to discuss the project related deliverables.
- Served as external examiner for the project evaluation of our M.Sc Chemistry final-year students, GITAM University on April 8th, 2024

Publications:

1. M. P. Shilpa, K. S. Ashadevi, S. J. Shetty, S. S. Bhat, N. Nalajala, V. Mishra, M. R Waikar, R. G Sonkawade, SC Gurumurthy, Noble metal decorated $Ti_3C_2T_x$ MXene for room temperature SO_2 detection, Sensors and Actuators A:Physical, 2025, 388, 116492. (IF:4.1)

Keynote/ Invited as speaker for international conferences/workhops:

1. Delivered an invited talk at School of Chemical Sciences, St. Joseph University, Bangalore.

New project proposals

1. Unveiling continuous process for methane to methanol conversion from sunlight harvesting using novel shape-engineered nanohybrids.
Scheme:Methane Monitoring and Mitigation Technologies (M^3T), DST
Budget: 70 Laks, Role: PI, Co-PI: Dr. Sanjeev P. Maradur Status: Under Review
2. Designing novel Metal and Covalent Organic Framework catalysts for the valorization of biomass derivatives furfural and furfuryl alcohol into value-added products
Scheme: DST-WISE fellowship
Budget: 30 Laks, Role: Mentor, Stuent: Ms. Meghana H, Status: Under Review

3. A pilot study of 42 m^2 photocatalyst panel assembly for green H2 and value-added chemicals from sunlight harvesting
Scheme: Climate, Energy and Sustainable Technology (CEST) Division and Hydrogen and Fuel Cell
Budget: 85 Laks, Role: PI, Status: Rejected

Dr. Naga Suresh Enjamuri
Assistant Professor
Materials Science and Catalysis Division
E-mail: nagasuresh@ppisr.res.in

BRIEF CV:

- January 2024 – till date, Assistant Professor, Materials Science and Catalysis Division,PPISR, Bengaluru, India.
- 2022-2023: Postdoctoral Research Fellow, Laboratory of Chemical System & Engineering, Hokkaido University, Sapporo, Japan.
- 2019-2022: Research Associate, Catalysis and Inorganic Chemistry Division, CSIR-National Chemical Laboratory Pune, Maharashtra, India.
- 2018-2019: Research Associate, Inorganic & Physical Chemistry Division, CSIR-Indian Institute of Chemical Technology, Tarnaka, Hyderabad, India.
- 2013-2018: Ph.D. IIT (ISM) Dhanbad, Jharkhand, India.
- 2011-2013: M.Sc. Chemistry, IIT Guwahati, Assam, India.

RESEARCH INTERESTS:

The main focus of Dr. Naga Suresh's group i.e., "CO_2BIOCAT" is involved an innovative and sustainable research approach focused on catalytic processes for the conversion of CO_2, biogas, and biomass-derived compounds into value-added fuels and chemicals using a variety of heterogeneous catalysts (It includes mixed metal oxides, metal nanoparticle supported metal oxides, bifunctional solid catalysts and mesoporous materials).Our research work aligns with the broader goal of achieving green and sustainable development by utilizing CO_2 and biomass as carbon sources.

- **Design and Development of Bifunctional Catalysts for Bio-Waste Derived Carboxylic Acids to Sustainable Aviation Fuels (SAFs)**

Sustainable aviation fuels (SAFs) production from bio-waste derived carboxylic acids are fascinating opportunity for decarbonizing the aviation sector as well as bio-waste management. In this context, SAFs plays a prominent role to achieve net-zero carbon emissions by 2050 for the aviation sector. Usually, SAFs mostly an assortment of normal paraffins, iso-paraffins and cyclo alkanes. A variety of biomass feedstocks are currently using for the production of SAF through several routes.Hence,novel bifunctional catalysts for the direct conversion of bio-waste derived carboxylic acids to SAFs is believed to be a promising strategy towards decarbonization in aviation sector.

- **Biogas upgradation via CO_2 methanation**

Our research focus on biogas upgradation through CO_2 methanation is indeed of great significance for both CO_2 utilization and addressing energy shortages. The utilization of surplus renewable energy for water electrolysis

to produce hydrogen, which is then used in CO_2 methanation to convert CO_2 to CH_4, represents a sustainable and environmentally friendly approach. In summary, our research is focused on a holistic approach that combines renewable energy, CO_2 utilization, and biogas upgradation to produce CH_4-rich gases. This aligns with the broader goals of sustainability, reducing greenhouse gas emissions, and providing an alternative energy source.

- **Catalytic conversion of lignocellulosic biomass to ethylene glycol (EG)**

Our research focus on the catalytic conversion of lignocellulosic biomass to ethylene glycol (EG) is crucial for advancing sustainable and environmentally friendly processes in the chemical industry. Ethylene glycol has widespread applications, and the transition from fossil feedstock to renewable sources like lignocellulosic biomass aligns with the goals of carbon neutrality and environmental sustainability.

- **C–O Hydrogenolysis of C_3–C_4 Polyols Selectively to Terminal Diols**

Our emphasis on glycerol as a biomass-derived platform chemical and its conversion to value-added products is in line with the principles of a circular economy, emphasizing the sustainable use of resources. Glycerol, a by-product in oleochemical industries, holds significant potential for the production of valuable chemicals, particularly propanediols (PDOs). In particular, diols with terminal hydroxyl groups are of great interest because of their vast applications. 1,3-Propanediol (1,3-PDO) is used in the production of poly(trimethylene terephthalate) (PTT). On the other hand, erythritol is a C_4 sugar molecule found in fruits, fermented foods, etc., and is widely used in cosmetics, artificial sweeteners and pharmaceuticals. 1,4-BDO is an important diol because of its extensive use in the synthesis of poly(butylene terephthalate) (PBT) polymer. A bifunctional, bimetallic catalyst can have synergistic interactions between the two metals which work in tandem to perform the surface-catalyzed reactions. Generally, a typical hydrogenolysis bifunctional catalyst consists of a noble metal and an acidic transition metal oxide.

- **Solid catalysts for conversion of furfural and its derivatives to alkanediols**

Our focus on the production of alkanediols with five and six carbon atoms, specifically 1,2- and 1,5-pentanediols, as well as 1,2- and 1,6-hexanediols, from lignocellulosic biomass-derived furfural and its derivatives is a commendable effort toward sustainable and green chemistry. The use of solid catalysts adds to the environmentally friendly approach. Several bifunctional catalysts with metal (for hydrogenation/hydrogenolysis) and acid/base (for ring opening) functionalities have been reported. Effective and selective conversion of furfurals to a desired diol is still a challenge.

RECOGNITIONS/ACHIEVEMENTS/AWARDS/MEMBERSHIP:

- Life Member of the Catalysis Society of India (CSI), Bangalore Chapter, since 31st January 2025
- Based on my satisfactory performance during the probationary period, the management of AMEF/PPISR has confirmed my appointment as Assistant Professor (regular position) with effect from 1st January 2025.
- Invited as the Chief Guest for the Annual Exhibition inaugural program at Poornaprajna Primary School, Yelahanka, on 29th November 2024, where I inaugurated the event and delivered the Chief Guest address.

STUDENTS

	PhD students		**M.Sc. interns' students**
1	Mr. Basavaraj Kumbarageri	7	Ms. Lavanya H. N
	Project Fellows	8	Ms.Hritujaya Bhowmik
2	Mr. Magudeshwaran	9	Ms. Ranjita R Naik

3	Mr. Kaviraj	10	Ms. Navitha M. V.
4	Ms. Harshitha C	11	Ms. Pavitra M Naik
5	Mr. Kartikeyan	12	Ms. Prateeksha V Naik
6	Mr. Ganesh N.	13	Ms. J. Maneesha

NATIONAL AND INTERNATIONAL COLLABORATORS:

(1) Prof. Ryuji Kikuchi, Hokkaido University, Japan.
(2) Dr. Shohei Tada, Associate Professor, Hokkaido University, Japan.
(3) Dr. Sudarsanam Putla, Assistant Professor, IIT Hyderabad
(4) Dr. Navneet Kumar Gupta, Assistant Professor, IISc Bengaluru
(5) Dr. Rawesh Kumar, Assistant Professor, Patna University.

RESEARCH 2024-2025:

CURRENT PROJECTS:

1. Synthesis of sulfates and carbonates from phosphogypsum and silicates via carbon dioxide mineralization.

Sponsored by: SABIC Research and Technology Pvt. Ltd.,
Duration:7 months (June 2024-December 2024)
Funding: Rs. 13.2 lakhs
Principal Investigator: Dr. Sanjeev P. Maradur& Dr. Ganapathi V Shanbhag
Co-investigator: Dr. Naga Suresh Enjamuri
Project Fellows: Mr. Kaviraj,Mr. Ganesh,Ms. Harshitha, Mr. Magudeshwaran and Mr. Karthikayan

I was a Co-PI in this SABIC project from June 2024 to January 2025. The project was successfully completed with the development of the product in Kg level with most of the objectives achieved and final project completion of the report was submitted to SABIC on 20th February 2025. Monthly project review meeting for the SABIC project Scope-4 Silicate work was held online on 20th November 2024. I have presented the results of work done during Oct.-Nov.2024 and myself and Dr. Sanjeev P Maradur and project students involved in the project from PPISR. The SABIC team members from their centers from India, Saudi Arabia and Houston, USA attended the meeting. Final project completion of review meeting for the SABIC project Scope-4 Silicate work was conducted. I have presented the results of work done during Nov.-Dec.2024 and myself and Dr. Sanjeev P Maradur and project students involved in the project from PPISR. The SABIC team members from their centers from India, Saudi Arabia and Houston, USA attended the meeting. All three of us (myself, Dr. Sanjeev P. Maradur (HOD & MSCD) and Dr. Naresh Nalajala) visited SABIC Research and Technology Pvt. Ltd, Bengaluru on 6th December 2024 to discuss about project progress and also to inquire regarding possibility of getting new project.

Status: The SABIC project Completed

2. Next Generation Cellulose Based NP Fertilizers

Sponsored by: SABIC Research and Technology Pvt. Ltd.,
Duration:45 days (October 2024-November 2024)
Funding: Rs. 1.5 lakhs
Principal Investigator: Dr. Sanjeev P. Maradur

Co-investigator: Dr. Naga Suresh Enjamuri
Project Fellow: Mr. Magudeshwaran
I was a Co-PI in this SABIC project from October 2024 to November 2024 until completion of the project and final submission of the all the reports to the SABIC.
Status: The SABIC project Completed

3.$Ce_xZn_{1-x}O_2$ mixed oxide catalysts for Efficient Ketonization of Propanoic Acid to 3-Pentanone
Research fellow: Ms. Basavaraj Kumbarageri
PhD Guide: Dr. Naga Suresh Enjamuri
Ketonization of carboxylic acids offers a highly effective strategy for upgrading bio-oil by reducing its oxygen content and enhancing fuel properties. In this study, a series of $Ce_xZn_{1-x}O_2$ catalysts with varying Ce/Zn ratios were synthesized and evaluated for the ketonization of propanoic acid to produce 3-pentanone, a valuable intermediate with improved thermal stability and hydrophobicity. Among the catalysts tested, $Ce_{0.7}Zn_{0.3}O_2$ catalyst exhibited exceptional performance, achieving >99% conversion of propanoic acid and >99% selectivity toward 3- pentanone at 350 °C, with stable catalytic activity maintained over a period of 3h. BET surface area analysis revealed that the all the catalysts possess mesoporous structures characterized by type-IV isotherms with H3 hysteresis loops. PXRD results indicated the formation of a CeO_2- dominated solid solution, with highly dispersed ZnO phase undetectable by diffraction. However, AAS, Raman analysis and FT-IR studies support the presence of ZnO in the $Ce_xZn_{1-x}O_2$ catalysts. CO_2 and NH_3-TPD measurements demonstrated that Zn incorporation significantly enhanced both the acidic and basic surface sites, which are crucial for propanoic acid ketonization activity. These findings highlight the potential of $Ce_xZn_{1-x}O_2$ catalysts for efficient bio-oil upgrading and contribute to the advancement of renewable fuel technologies through catalytic conversion of low-molecular-weight carboxylic acids.

Status: Under progress

2. **Design and development of bimetallic and trimetallic mixed oxide catalysts for conversion of valeric acid to 5-nonanone via ketonization.**

Research fellow: Ms. Basavaraj Kumbarageri
PhD Guide: Dr. Naga Suresh Enjamuri
CeO_2-ZnO mixed metal oxide catalysts were developed using sol-gel method for the ketonization of valeric acid to sustainable aviation fuels precursor 5-nonanone. As from BET surface area analysis, we observed that CeO_2-ZnO mixed metal oxide catalysts are in mesoporous in nature and it is type IV with H3 hysteresis loop indicates that it has non-rigid aggregate (or) slit shape (or) plate like pores exhibit unlimited absorption at high P/Po. H3 isotherm may also be attributed to pore blocking due to percolation effect. XRD patterns of CeO_2-ZnO mixed oxide catalysts showed diffraction peaks are attributable to the fluorite phase of ceria in all cases and ZnO crystal phases at 2theta values of 31.7, 34.4, 36.2 and 63.0 are observed for the CeO2-ZnO catalysts with different ZnO contents. The catalytic activity results will need to be done.
Status: Under progress

Submitted Research Proposals for Government Sponsored Projects:

(1) Project Title: "Design and Development of Novel Bifunctional Catalysts forDirect Conversion Wet-Waste Derived Carboxylic Acids to SustainableAviation Fuels: A Path Towards Decarbonization in Aviation Sector.
Principle Investigator: Dr. Naga Suresh Enjamuri
Funding Agency: Anusandhan National Research Foundation (ANRF)under the Prime Minister-Early Career Research Grant (PM-ECRG)
Submission date: 18th November 2024
Research Grant: Rs: 59,12,808/-
Status: Not recommended

(2) Project Title: "Design and Development of Catalyst and Process for the C-H Activation of Methane to Acetic Acid via Carbon dioxide Fixation"
Principle Investigator: Dr. Sanjeev P Maradur
Co-Principle Investigator: Dr. Naga Suresh Enjamuri
Submission date: 31st March 2025
Funding Agency: DST CH_4 Call-2025
Research Grant: Rs. 67,53,794/-
Status: Under review
The main objective of the proposed work is to design and development of an efficient catalyst for C-H activation of methane to acetic acid production via CO_2 fixation route.

Submitted Research Proposals for Industry sponsored projects:
(1) Project Title: Development of titanosilicate based zeolite catalysts for theepoxidation of linear alpha olefins using hydrogen peroxide.
Sponsored by: M/s Jeevan Chemicals Pvt Ltd., Gujarat.
Duration: 1Year
Submission date: 29th July 2024
Funding: Rs. 24,88,200/-
Principal Investigator: Dr. Naga Suresh Enjamuri
Co-investigator: Dr. Sanjeev P. Maradur

Status: The project proposal has been submitted. We are in talks with them fora possible finding. Scientists from Jeevan Chemicals have agreed to visitPPISR for the final round of discussions. However, there is no response from Jeevan Chemicals Pvt Ltd., Gujarat.

(2) Project Title: Naphtha processing in vapor phase in fixed bed to improve itsRON typical operating conditions: Temp. 500°C max. and Pr. 7kg/cm^2g max.
Sponsored by: Chemdist and Excel tech Pune
Duration: 3 months
Submission date: 11th September 2024
Funding: Rs. 8,08,500/-
Principal Investigator: Dr. Sanjeev P. Maradur
Co-investigator: Dr. Naga Suresh Enjamuri

Status: The project proposal has been submitted. Scientists from Chemdist andExcel tech Pune have agreed to visit PPISR for the final round of discussions.However, there is no response from client side said by Chemdist and Excel tech Pune. They have approached to another client and waiting for their confirmation.

Events and Achievements (2024-2025):

- I prepared a brochure for the Materials Science and Catalysis Division of PPISR with the objective of publicizing our institute and attracting potential industry-sponsored projects
- I prepared a PPISR-Newsletter 2024 which includes research highlights of each group operating in varied scientific areas, including publications, research activities, important events, and milestones at PPISR all over the year 2024.
- I took charge of organizing and conducting the PPISR Sports Day celebration on 12th March 2025.

Publications:

(1) **N. Enjamuri**, So Nishikawa, M. Nishijima, S. Tada, R. Kikuchi. Highly active and stable Ru promoted Ni/CeO_2 catalysts for CO_2 methanation reaction. ASAP Article, *The Canadian Journal of Chemical Engineering*, 2025. DOI:**10.1002/cjce.25708**

New Recruitment

Dr. Shivakumar K. I.
Assistant Professor
Materials Sciences and Catalysis Division
E-mail: shiva@ppisr.res.in

BRIEF CV:

2025 March – present	Assistant Professor, Poornaprajna Institute of Scientific Research (PPISR)
2023 March – 2025 March	Senior Postdoctoral Researcher, Faculty of Env. Earth Sci., Hokkaido University, JAPAN
2021 March – 2023 March	ICReDD Researcher, Institute for Chemical Reaction Design & Discovery, Hokkaido University, JAPAN
2019 May – 2021 March	RIES Postdoctoral Fellow, Research Institute for Electronic Science, Hokkaido University, JAPAN
2017 Dec. – 2019 April	Postdoctoral Researcher, CBMM, Polish Academy of Sciences, Łódź, POLAND
2017 Aug. – 2017 Nov.	SERB-National Postdoctoral Fellow, IIT Guwahati, INDIA
2011 Jan. – 2017 May	PhD, CSIR-National Chemical Laboratory, Pune, INDIA
2010 Sept. – 2010 Dec.	Visiting Research Student, Raman Research Institute, Bengaluru, INDIA
2008 July – 2010 May	M.Sc. Chemistry, National Institute of Technology Karnataka, Surathkal, INDIA
2009 May – 2009 July	Summer Research Intern, IIT Bombay, Mumbai, INDIA
2004 July – 2008 May	B.Sc.Ed., Regional Institute of Education (NCERT), Mysuru, INDIA

RESEARCH INTERESTS:

At the Advanced Functional Materials (AFM) Lab, our mission is to explore and develop functional materials for emerging technologies. We focus on the rational design and synthesis of organic, short- and long-chain polymeric, and metal–organic hybrid molecules for the development of functional materials with precisely tuned structural and physicochemical characteristics. Our research explores how these tailored molecules self-assemble, adopt defined conformations, or organize into porous frameworks. We investigate the resulting properties in the context of next-generation electronic materials and crystalline porous materials for molecular recognition and selective uptake of guests with a special emphasis on environmental sustainability.

RECOGNISTIONS/ACHIEVEMENTS:

2024: Silver Award, 10th Hokkaido University Interdepartmental Symposium Research Grant
2018: Vidyarathna Award, Bengaluru
2017: SERB-National Postdoctoral Fellowship
2011-2015: CSIR-UGC Junior and Senior Research Fellowships
2010: Qualified GATE-2010 in Chemistry
2010: Prof. G. U. Kulkarni Gold Medal for securing first rank in M.Sc. Chemistry
2010: NITK Gold Medal for securing first rank in M.Sc. Chemistry program

RESEARCH:

SPONSORED PROJECTS (2023-2024):

1. **Title of the project**: Direct Air Capture and On-Demand Release of CO2 Using a Light-Swing Mechanism in a Covalent Organic Framework.
   Funding Agency: Silver Award, 10th Hokkaido University Interdepartmental Symposium Research Grant, under the Grant for the Promotion Project for Young Investigators, Hokkaido University (2021–2026).**Role**: PI, **Budget**: ¥ 600,000, **Grant year**: 2024, **Status**: Completed

Total publications: 11
Total Patents Granted: 1

Keynote/ Invited as speaker for international conferences/workshops (2024-2025):

- Sophia University, Tokyo (May 2024)
- Embassy of India in Japan, Tokyo (October 2024)

Other Scientific Activities (2024-25)

- Convenor, Indian Scientists Association of Japan (ISAJ) Hokkaido 2024 Symposium, held on Dec 13, 2024, at Hokkaido University, Sapporo, Japan.
- Joint Secretary, Hokkaido and Tohoku Chapter, India Japan Society for Science, Technology & Education (IJSSTE), 2023-2025.

Biological sciences division

Mission and research progress

Established in 2010 alongside the Materials Sciences Division, the Biological Sciences Division at PPISR is dedicated to the discovery of novel, naturally derived therapeutic molecules aimed at addressing chronic diseases such as diabetes and cancer. Our pioneering research in detoxifying enzymes, bioconjugation of therapeutic agents, and immunotherapy has led to numerous high-impact publications and patent applications.

To support nationwide research needs, the division houses state-of-the-art in-house facilities for evaluating antimicrobial activity, antioxidant potential, anti-diabetic efficacy, and more. These resources are actively utilized by researchers across India.

A recent highlight is the Smart Chem Bio Lab, which focuses on designing light-responsive molecules that offer precision control over biological functions and material properties. This cutting-edge research paves the way for smarter therapeutics with minimal side effects, advanced tools for disease understanding, and materials with tunable characteristics. For sponsors and collaborators, we offer not only the thrill of frontier science but also the assurance of developing bespoke molecular solutions—from breakthrough healthcare innovations to custom-engineered smart materials tailored to real-world applications.

The division also welcomes aspiring scientists through internship opportunities in chemical biology, microbiology, molecular biology, and biochemistry. Training at PPISR is uniquely hands-on, ensuring that every undergraduate and postgraduate gains practical experience across all subfields of biology and chemical biology. Several lab-scale projects with proven industrial relevance are available for interested funders and partners.

The microbiology group headed by Dr. Ananda K., mainly focuses on finding natural inhibitors from medicinal plants and their endophytic fungi, for the enzymes involved in carbohydrates metabolism and insulin for treating diabetes. Dr. Ananda's group are also interested in laccase enzymes and their role in bioremediation. Till now, eight students obtained their PhD degree from Biological Science division registered under Manipal Academy of Higher Education (MAHE), Manipal and few are working for their PhD program.

Dr. Ananda K

Associate Professor & Director (I/C)
Biological Sciences Division
E-mail: ananda@ppisr.res.in

Major Areas of Research

Dr. Ananda specializes in molecular and chemical modification of proteins, enzymes, and bioactive molecules derived from plants and fungi. Their research spans three broad areas:

1. Designing and selectively modifying proteins to develop lead drug molecules or drug delivery systems, while enhancing their stability and half-life.
2. Exploring bioactive compounds from plant and fungal sources to identify potential treatments for diabetes, cancer, depression, and other diseases.
3. Optimizing fungal enzymes for efficient degradation of lignin, industrial dyes, and antibiotics.

RESEARCH INTERESTS:

In the biological sciences division, we are involved in studies such as,

1. Design of proteins to create lead molecules for the therapeutic purpose
2. Bioconjugation of therapeutically important proteins to increase their half-life
3. Novel anti-diabetic, anti-bacterial metabolites from plants and microbial sources
4. Proteins secreted by endophytic fungi for degradation of lignin, industrial dyes, and antibiotic molecules.
5. Mitigation of phytoplasma infection in sandal wood using potential endophytic fungi.
6. Biological activities of synthetic compounds and chemically modified polymers

Patents filed as Inventor:

1. Indian Patent (Application No. 202341002384) filed by PPISR in the title " Biologically Active Zinc-Free Hexameric Insulin Analogues" Inventors are Dr.Udupi Ramagopal, Dr.Shrilakshmi S, Dr. Shankar Kundapur and **Dr.Ananda K**,
2. Indian Patent filed (Application No.202441017114) on the title**:**Poly(vinyl chloride)-G-1-(2-aminoethyl piperazine) polymer for antimicrobial paint composition and its method of preparation thereof: filed by MAHE Manipal, and inventors are Dr.Yashoda M. Puttaiahgowda (MIT, Manipal) ,**Dr.Ananda Kulal (PPISR, Bengaluru**) and Ms.Sonali Gupta (MIT, Manipal).

Training of Students:

PhD Awarded PI	: 05
PhD Awarded Co-PI	: 01
PhD Guiding	: 02
MSc Project completed	: 08
BSc/BE Project completed	: 09
BSc Inspire students	: 03
PhD students guided in Collaboration (MIT, MAHE)	: 05

RECOGNISTIONS/ACHIEVEMENTS:

- Appointed as Director (Incharge), PPISR, Bengaluru since January 7, 2025.
- Promoted as Dean (Academics), PPISR, Bengaluru since November 2024
- Recognised as Visiting Professor of Dept. of Biochemistry, Mangalore University, Mangalore during 2020-21. Adjunct Professor of MAHE Manipal Since 2022. Visiting Professor REVA University, Bengaluru since 2021.
- PhD Co-coordinator for Manipal Academy of Higher Education (MAHE), Manipal
- Life Member of Mycological Society of India
- Life member of Association of Microbiologist of India
- Postdoctoral Senate member in Faculty Senate, Quality of Life Committee and of Committee on Committees of Albert Einstein College of Medicine 2007-2009.
- President of Mangalore university researcher's forum (MURF) during the period of Ph.D. for a year.
- Member of New York academy of science, NY, USA.2006-2008
- Member of Protein Society, San Diego. USA 2006.

STUDENTS

PhD Graduates:

1. Dr.Pavithra N, 2. Dr.Sathish L, 3. Dr. Kavitha K N, 4. Dr.Kirana M P, 5. Dr. Shrilakshmi S, 6. Dr.Shreya Kanth (Co-PI)

PhD students (PI/Co-PI) (2024-25)

1. Mr.Mallikarjun, 2. Ms. Akshitha PS, 3. Ms. Deepika M

MSc Project Students (2024-25)

1. Patel S K

RESEARCH:

SPONSORED PROJECTS (ongoing):

Nill

ACADEMIC PROJECTS:

1. **Investigation of magic molecules from the selected fungi for the inhibition of starch hydrolysing and aldose reductase enzymes**
   PhD Supervisor**: Dr. Ananda K**

   Student: **Mallikarjun M**

Diabetes mellitus is one of the top 10 leading cause of death worldwide were type 2 diabetes accounts for the 90% of the cases. Few enzymes like alpha amylase and alpha glucosidase places a major role in starch digestion and glucose absorption. By controlling these enzymes, we can combat the hyperglycemic condition which plays a major role for diabetes mellitus to occur. Literature survey was carried out on these enzymes. Endophytic fungi named as AP1AR3, AP3BRh2 and AP1BRh1 extracted from *Curcuma longa* was sub cultured using YPF media and secondary metabolites were extracted. The YPF media avoid the detection of sugars from the media (Potato dextrose broth) which was previously used. ABTS and DPPH essays were performed for both the samples. During the final standardization, AP3BRh2 showed IC_{50} of 15.01 µg/ml for ABTS assay and IC_{50} of 116.10µg/ml for DPPH assay. The ABTS assay of AP1AR3 indicated IC_{50} of 132.63 µg/ml, there was no consistent result for DPPH assay and troubleshooting is being carried out to obtain a proper result. Alpha glucosidase inhibition assay was performed on AP1AR3 sample by dissolving it in 5%DMSO which didn't yield any notable results.

Further the test was carried out using methanol for initial dilution and subsequent dilution was done using Mili q which initially gave good result for higher dose concentration. However, upon decreasing the concentration, the results were not consistent. Troubleshooting is being carried out get the result. DNA was isolated from the sample AP1AR3, AP3BRh2 and AP1BRh1 which was stored in mili q water. But the DNA started to get denatured and PCR amplification was not occurring and hence it was stored in TE buffer, DNA was stable for few days. Again, after few days the DNA started to get denatured. The issue is still under study condition.

Status: Ongoing

2. **Preparation of conjugated protein as a plasma expander for the transfusion and cell storage stabilizer for the long-term storage of cells**.
   PI: Dr. Ananda K, Biological Sciences, PPISR, Bengaluru
   Co-PI: Dr.Guruprasad Kalthur , Professor and Head, Department of Reproductive Science, KMC, MAHE, Manipal.

The project is temporarily halted due to non-availability of working student. Will be continued soon.
Blood transfusion with a artificially modified protein are gaining importance recently, due to their increased viscosity and retaining balanced colloidal osmotic pressure. There are efforts are being made to achieve this type of molecule using hemoglobin, albumin etc. However, in the market there are no such valuable molecules available which can maintain the plasma concentration stable without much extravasation. In this project we are preparing bio-conjugated albumin as a plasma expander for the application of blood transfusion in emergencies. The similar bioconjugated albumin is also prepared and tested for its ability in enhancing the storage of human

cells as well as storage of human sperms being studied recently in collaboration with KMC, Manipal. The initial results indicated that there is an increased activity of sperms in the bio-conjugated media when compared to the existing media. Further detailed studies will b e conducted in future based on the funding opportunity.

Status: Ongoing

3. Effective management of spike disease in Indian sandal wood by studying endophytes of infected and healthy plants

PI: Dr. Ananda K, MSc Project Student: Ms. Malavika

Studies related to the endophytic fungi isolated from healthy *Santalum album L* (Sandalwood) plants continued. A more detailed study on five endophytic fungi was made. The antimicrobial activity and their MIC studies were very interesting and one of these fungi shown highest activity and more studies on this isolate is needed. The DPPH and ABTS studies, phytochemical analysis of the endophytic fungal isolate's extracts was also completed. The best fungi were grown again, and total DNA was isolated for the molecular sequencing. The manuscript is under communication.

Status: The manuscript prepared and it is under correction and need to be communicated soon.

4. Estimation and extraction of omega-3-fatty acids from Purslane (NELABASALE) and its endophytic fungi
PI: Dr.Ananda K, MSc Intern Student: Ms.Medhini

Omega -3-fatty acid from a plant and fungal source might have higher value as a vegetable source. The plant Purslane, (*Portulaca oleracea)*, known for its high alpha linoleic acid (ALA) acid which is an essential fatty acid need to get from external sources in our food. ALA is one of the fatty acids in omega-3-fatty acids. We have estimated the total fatty acids and DHA in the extracted samples from this plant. Three endophytic fungi out of ten shown fatty acid contents and one of them was producing highest amount compared to others is studied in more detail.

Status: The manuscript prepared and it is under correction and need to be communicated soon.

5. Plastic degradation by fungal enzymes isolated from the fungi growing on plastics.
PI: Dr. Ananda K, MSc Intern Student: Ms. Akshitha PS

Degradation of plastics in nature usually takes decades of years and complete mineralization is still impossible. However, there are attempts made to degrade plastics using chemicals, radiation and biological routes that were not very successful. The need for plastic degradation is the most essential requirement at present. We have collected plastics which are already disposed to the surroundings and washed them using tap water followed by milli-Q water to remove any derbies, using a scissor 10-15 mm dimensions of pieces were made and incubated on agar medium containing antibacterial agents. After few days, the fungi growing on the plastics were isolated and grown on potato agar media. Later, these fungi were grown in a flask containing potato dextrose media and 10 mg of plastic piece. After 21 days of culturing the weight loss in plastic pieces was monitored and there was about 2-4% of weight loss found in one of the incubated isolates. The project will be continued in future.

Status: This project was continued, and data collected needs to be analyzed, data may not be enough for a full manuscript. However, we have prepared a review on plastic degradation by microbes. Need to think if we can combine these and try to communicate to a journal.

RESEARCH HIGHLIGHTS:

Published papers:

Total publications: 64

Publications for the year 2024-25:

1. S. S. Rao, S. V. Kundapura, D. Dey, C. Palaniappan, K. Sekar, A. Kulal, U. A. Ramagopal. Cumulative phylogenetic, sequence and structural analysis of Insulin superfamily proteins provide unique structure-function insights.*Molecular Informatics.* (2024) e202300160.
2. D. Dwarakanath, Y. N. Nayak, A. Kulal, S. Pandey, K. S. R. Pai, S. L. Gaonkar, In vitro and in silico insights into antimicrobial and anticancer activities of novel imidazo[2,1-b][1,3,4] thiadiazoles Scientific Reports 14 (2024) 31994.
3. D. Dwarakanath, Y. N. Nayak, A. Kulal, S. Pandey, K. S. R. Pai, S. L. Gaonkar, Synthesis, characterization and in silico studies of novel multifunctional imidazole-thiazole hybrids with potent antimicrobial and anticancer properties. Scientific Reports, 15, (2025) 9809.
4. D. Dwarakanath, A. Kulal, B. Basappa, Z. Xi, V. Pandey, B. R. Bharath, S. L. Gaonkar, Synthesis, computational studies and evaluation of benzisoxazole tethered 1,2,4-triazoles as anticancer and antimicrobial agents, Journal of Molecular Structure, 1308 (2024) 138070.
5. S. Gupta, Y. M. Puttaiahgowda, A. Kulal,' Development and evaluation of antimicrobial PVC-grafted polymer for enhanced paint applications, *RSC Advances*, **14** (2024) 25669-25677.
6. S. Gupta, Y. M. Puttaiahgowda, A. Kulal,' Unveiling the effectiveness of antimicrobial BPJ polymer coatings in enhancing microbial resistance, Materials Advances, **5** (2024) 5855-5869.

Patents Filed:

1. Indian Patent Application No. 202341002384, Biologically active zinc-free hexameric insulin analogues, (2023), Inventors: Ramagopal UA, Rao SS, Kundapura S, Ananda K. Published online and it has been referred to Examination.

Resource person/papers presented in conferences:

1. Dr. Ananda K, Associate Professor, Biological Sciences Division presented a paper on the title "Carbohydrate digesting enzyme inhibition by an endophytic fungus isolated from a medicinal plant" in an International conference named " The Role of Fungi in Sustainable Development: From Exploration to Application" conducted by the Association of Fungal Biologists (AFB-CON 2024) on October 23-25, 2024 and Received FIRST PRIZE under Oral Presentation Awards category.

Total presentations: 32

For the year 2024-25: Nil

Other Scientific Activities (2024-25)

1. Dr. Ananda K Associate Professor, made an presentation about the Research activities of Biological sciences and its achievements during the visit of Dr.P. S. Aithal, Director of Poornaprajna Institute of Management and Director (Developments) Poornaprajna group of Institutions on June 21, 2024.
2. Mr.Mallikarjun M prepared and presented PhD protocol Titled :"Investigation of magic molecules from selected fungi for the inhibition of starch hydrolysing and aldose reductase enzymes"to the DAC Members of MAHE Manipal on 02-04-2024 and subsequently completed his PhD registration under MAHE Manipal.
3. Ms. Akshitha P, JRF attended online seminar titled "Lichen research in India: Progress and prospects" presented by Dr. Sanjeeva Nayaka which was organized by Mycoasia on 30/06/2024.

4. Mr.Mallikarjun M, Research Scholar, Biological Sciences prepared and presented Six month progress report-1 on PhD thesisTitled :"Investigation of magic molecules from selected fungi for the inhibition of starch hydrolysing and aldose reductase enzymes" to the DAC Members on July 31,2024 and sent to MAHE Manipal.
5. Dr. Ananda K Associate Professor, monitored all the students of PPISR for their Six months DAC meetings, thesis submission, Registration under MAHE Manipal related communications and follow-ups during this period.
6. Dr.Ananda K, Associate Professor, attended as Subject expert and evaluated biannual presentation of 08 PhD Scholars of Department of Biotechnology, REVA University, Bengaloure on July 30, 2024.
7. Dr.Ananda K Associate Professor, submitted proposal for the Animal studies in collaboration with Mangalore University was approved by the Institutional Animal Ethics Committee, Mangalore University, Mangalagangothri - 574 199 on September 10,2024. The animal studies on bio-conjugated protein and insulin molecules will be studied under this approval.
8. Dr.Ananda K Associate Professor, submitted proposal for the Animal studies in collaboration with Mangalore University was approved by the Institutional Animal Ethics Committee, Mangalore University, Mangalagangothri - 574 199 and work related to this is discussed with the collaborator in two meetings.
9. Mr.Mallikarjun M, Research Scholar, Biological Sciences prepared and presented Six month progress report-2 on PhD thesis Titled: "Investigation of magic molecules from selected fungi for the inhibition of starch hydrolysing and aldose reductase enzymes" to the DAC Members on December,2024 and sent to MAHE Manipal.
10. Dr. Ananda K Associate Professor, monitored all the students of PPISR for their Six months DAC meetings, thesis submission, Registration under MAHE Manipal related communications and follow-ups during this period.

RESEARCH COLLABORATION (2024-25)

1. Department of Chemistry, Manipal Institute of Technology, MAHE, Manipal.
2. Department of Chemistry and Department of Zoology, Mangalore University, Mangalore
3. Department of Biochemistry, St. Aloysius College, Mangalore
4. Forest Protection Division, Institute of Wood Science and Technology, Bengaluru

EVENTS AND OTHER ACHIEVEMENTS:

1. Appointed as Director (Incharge), PPISR, Bengaluru since January 7, 2025.

2. Dr.Ananda K Associate Professor chaired a session for biology on the Scientific presentation organized during the Founder's Day 2024 and Mr. Mallikarjun M, presented a seminar on a title "Mushroom as foodand medicine" on 04/07/2024.

3. Dr. Ananda K Associate Professor, appointed as External examiner for the Department of environmental Sciences, Mangalore University, Mangalore and evaluated MSc Projects and Theory examination papers on August 17, 2024.

4. Dr. Ananda K Associate Professor, appointed as External examiner for the Department of Microbiology, Yenepoya University, Mangalore and conducted practical exams and evaluated on 08-05-2024.

5. Dr.Ananda K, Associate professor, Biological Sciences was given a new responsibility of Dean (Academics) of PPISR with effect from November, 2024 to oversea all the day to day activities of PPISR and reported to the Director.

Theoretical Sciences Division

Mission and research progress

Theoretical science seeks to unravel the scientific and mathematical structure underpinning Nature and Her physical laws, and how these relate to the macro-world in a testable way. The broad research areas of the Division include quantum many-body and mesoscopic physics, nanoscience, quantum information theory, quantum foundations and Solar physics. Currently, there are five PhD students in the group, Mr Rahul S, Mr Ranjith Kumar R and Mr Y R Kartik with Dr S. Sarkar and Mr Shrikant U and Mr Vinod N Rao with Dr R. Srikanth. Two students have already obtained their PhD with Dr. R. Srikanth, and a postdoc had worked under Dr S. Sarkar. The students were all hired under DST/SERB or DRDO projects. All of our former students have moved on either to postdoctoral work in eminent research groups or taken up faculty positions in a university. The Doctoral Advisory Committee (DAC) members overseeing the current set of students are Prof. C. Sivaram (Emeritus, IIA, Bangalore), Prof. B. S. Ramachandra (Director, CFRCE, Benaluru), Prof. Rajeev Joshi (Dept. of Physics, Central University of Karnataka) whose areas of expertise span theoretical astrophysics, black hole cosmology, soft condensed matter and crystallographic studies.

Mission Goals

- Probing the nature of the quantum state by operational means including cryptography and measurement disturbance, rather than a specific ontological framework.
- Exploring the interplay of topology and interactions in light-matter systems, and its specific manifestations such as Zak-Berry phase
- Exploring foundational and practical issues pertaining to practical quantum information pro- cessing, in particular in the context of quantum open systems and quantum cryptography.
- Temporal & spatial analysis of Solar supergranulation.

Glimpses of Current Research

- Quantum criticality of geometric phase in coupled optical cavity arrays under linear quench
- Temporal self-similarity as a strong witness of quantum non-Markovianity
- Counterfactual and twin-field quantum digital signatures
- Solitons and spin transport in an antiferromagnetic spin chain
- Relation between non-Markovianity and non-invertibility of Pauli qubit and qudit channels.
- An interplay of topology and quantized geometric phase for two different symmetry-class Hamiltonians
- Fractal dimension, phase and activity level of Solar supergranulation

Prof. Sujit Sarkar
Associate Professor
Theroetical Science Division
E-mail:sujit.tifr@gmail.com

BRIEF CV:

- Associate Professor, PPISR: Jan 2018—present
- Assistant Professor, PPISR: 2007 – 2017
- Faculty Fellow, PPISR: 2005 – 2007
- IISc Physics Department (year 1997-1998)
- Bar-Ilan University, Physics Department (year 1999-2000)
- Max-Planck Institute, Germany as a Guest Scientist (year 2000-2002)
- The Weizmann Institute of Science (year 2002-2005).
- Associateship position at S. N. Bose National Centre for Basic Sciences (since 2016 and continue)
- Visiting Scientist Positions: Tata Institute of Fundamental Research (Mumbai) National Centre for Theoretical Science (NCTS, Taiwan), Karl-shrue Institute of Technology, Germany.

RESEARCH INTERESTS:

(1). Quantum Many Body Physics and Quantum Field Theoretical Studies of Quantum Condensed Matter System.
(2). Conformal Field Theory Study for Quantum Spin System.
(3). A Detail Study of Dirac Equation on and off the quantum critical lines.
(4). Quantum Phase Transition and Topological Quantum Phase Transition.
(5). Geometric Structure of Space-Time and Quantum Geometrical Tensor.
(6). Interacting Disorder System.

RECOGNITIONS/ACHIEVEMENTS:

- **Seminars, Lectures, Workshops and Conferences:**

(1). Two Seminars on Conformal Field Teory:Department of Physics, Burdwan University- September 2024.
(2). One Presentation on My Research at the DST-SERB New Delhi (November, 2024).
(3). Indian Statistical Physics Community Meeting February'2025.
(4). One Regular Seminar in PPISR February'2025.

- **Students:**

1. Mr. Vaishnav Mallya (Project Student, CRG/2021/000996)
2. Dr. Vijay Pathak (Postdoctoral Student, Partially Working with Me.

RESEARCH

CURRENT ACADEMIC PROJECTS:

1). 4th DST PROJECT: Emergence of quantum criticality for hermitian and non-hermitian topological state of quantum matter. Principal Investigator: Sujit Sarkar

- **Current Research Projects:**

(1). A study of Conformal Field Theory for Quantum Matter System:

We study and present the results of central charge for quantum Ising model with longer range interaction. This model Hamiltonian system has three gapped phase with different topological index and three quantum critical lines also with different topological index. We also present the conformal field theory study for this model Hamiltonian system and present the central charge for the different regimes of the parameter space. We show explicitly non-universal, i.e, for the same value of central charge behaviour of topological states are different. This model Hamiltonian system consists of two multiple quantum critical points, one is topologically trivial and the other is topologically non-trivial. We also present the effect of transverse field on the quantum critical line and also for the evaluation of central charge. We present explicitly difference between the quantum Ising model and the quantum Ising model with longer range interaction. We show explicitly that the minimal model which describe the cft behavior of quantum Ising model is not sufficient to describe the behaviour of quantum Ising model with longer range interaction. Apart from that we show explicitly on the interplay of criticality and topology. This work will provide a new perspective in topological state of conformal field theory.

(2). Interplay of Topology, Criticality and Edge Mode Physics for Hermitian and non-Hermitian Quantum Many Body System

The interplay between topology and criticality has been a recent interest of study in condensed matter physics. A unique topological transition between certain critical phases has been observed as a consequence of the edge modes living at criticalities. In this work, we generalize this phenomenon by investigating possible transitions between critical phases which are non-high symmetry (non-HS) in nature. We find the triviality and non-triviality of these critical phases in terms of the decay length of the edge modes and also characterize them using the winding numbers. The distinct non-HS critical phases are separated by multicritical points with linear dispersion at which the winding number exhibits the quantized jump, indicating a change in thentopology (number of edge modes) at the critical phases. Moreover, we reframe the scaling theorynbased on the curvature function, i.e. curvature function renormalization group method to efficiently address the non-HS criticalities and multicriticalities. Using this we identify the conventional topological transition between gapped phases through non-HS critical points, and also the unique topological transition between critical phases through multicritical points. The renormalization group flow, critical exponents and correlation function of Wannier states enable the characterization of non-HS criticalities along with multicriticalities.

List of Publications:

(1). Topological transition on a conformal manifold for the quantum Ising model with a longer range interaction: Sujit Sarkar (Single Author)
Scientific Reports | (2025) 15:5916 | https://doi.org/10.1038/s41598-025-89901-5

Dr R. Srikanth
Associate Professor
Theoretical Sciences Division
E-mail: srik@ppisr.res.in

BRIEF CV:

- January 2018 – till date, Associate Professor, PPISR, Bengaluru, India
- 2010 – 2017: Asst. Professor, PPISR, Bengaluru, India
- 2006 – 2010: Faculty Fellow, PPISR, Bengaluru, India
- 2003 – 2006: Postdoc, RRI, Bengaluru, India
- 2000– 2003: Research Associate, CTS, IISc, India
- 1999 : PhD IIA and IISc, Bengaluru, India

RESEARCH INTERESTS:

- **Quantum cryptography:** Various areas studied include quantum steganography, quantum secret sharing, quantum key distribution, key agreement, twin-field quantum systems, and relativistic quantum information.
- **Quantum foundations:** Areas studied include Quantum causal modelling, the tradeoff between indeterminism and signaling in causal models of quantum nonlocality, information based reconstruction of quantum mechanics and its implications for quantum speedup, nonlocality and contextuality of indistinguishable particles.
- **Quantum information processing and Open quantum systems:** Quantum codes with entanglement assistance, maximally nonlocal subspaces and their possible applications to state or subspace certification. Other areas studied include (non-)Markovianity, distinguishability, information flow, concatenating quantum codes, bath engineering to produce non-markovianity, measure of non-Markovian maps.

RECOGNITIONS (2024 - 2025):

1. Dr. Srikanth was part of a team put together by Karnataka Science and Technology Association (KSTA) tasked with submitting a report to Karnataka Govt on fostering quantum technologies.
2. Hindu Dharma Acharya Sabha kindly invited me to participate as a speaker and panelist (from a Science perspective) in " Science and Spirituality Dialogue " held in Sivananda Ashram, Ahmedabad .
3. Acted as referee for papers submitted to various prestigious international journals, such as Physical Review E, Journal of Physics A (Mathematics & General), Physical Review X, Physical Review A, Quantum Information Processing.
4. Dr R Srikanth facilitated an online course at PPISR by Prof. Kallol Roy, an alumnus of PPISR and current Professor of Data Science at Tartu University, Estonia.

STUDENTS (2024-2025):

1. Dr. Vijay Pathak (postdoc, working in the area of quantum non-Markovianity, information backflow, divisibility of quantum channels)

2. Mr. Sanjoy Dutta (PhD student, working in the area of hybrid quantum systems, entanglement-assisted quantum error correction, quantum steganography)
3. Mr. Shubhodeep Gangopathyay (PhD student, working in the area of quantum network nonlocality, quantum secret sharing)

GROUP ALUMNI:

A) PhDs

1. Dr. Vinod N Rao: Area: feasibility studies of practical counterfactual quantum cryptography (July 23, 2023); currently at the quantum technology group, York University, UK.

2. Dr. Shrikant Utagi: PhD topic: ASPECTS OF NON-MARKOVIANITY IN OPEN QUANTUM SYSTEM DYNAMICS AND QUANTUM COMMUNICATION (11 Oct, 2021) ; currently postdoc at Physics Dept, IITM.

3. Dr. Aravinda S. PhD Title: "Aspects of quantum contextuality" (19 June, 2017); currently Professor of physics at IIT Tirupati.

4. Dr Amkar S: PhD topic: "QUANTUM NOISE DUE TO DISSIPATIVE AND NON-DISSIPATIVE INTERACTION WITH A SQUEEZED CODES AND CHARACTERIZING QUANTUM DYNAMICS"; currently, quantum technology officer at Orca Quantum Computing, Canada

B) Post-Doctoral Fellows:

1) Dr. Rohit Kishan Ray. 2023-2024: He worked in my DST project CRG/2022/008345.

2) Dr. V Ranjith 2017-2018: He worked in my DRDO project ""Feasibility Study of a Practical Realization of Protocol for Semi-Counterfactual Quantum Key Distribution (QKD)"

NATIONAL AND INTERNATIONAL COLLABORATORS:

1. Prof Franceco Petruccione, Univ. of Stellenbosch, SA
2. Prof. Subhashish Banerjee, IIT Jodhpur
3. Prof Debajyoti Gangopadhyay, Annada College, VBU, Hazaribag
4. Dr. Vinayak Jagadish, CIT Chennai
5. Prof S. Aravinda, IIT Tirupati

RESEARCH 2024-2025:

CURRENT PROJECTS:

1) Quantum steganography using catalytic and entanglement-assisted quantum codes
Principal Investigator: Dr. R Srikanth
Research fellow: Mr. Sanjoy Dutta

2) Decoherence-free subspaces and Markovian revival of genuine multipartite entanglement in a dissipative system
Principal Investigator: Dr. R Srikanth
Research fellow: Mr. Shubhodeep Gangopadhyay

3) Distinguishability vs information backflow in the characterization of quantum non-Markovianity
Principal Investigator: Dr. R Srikanth

Research Associate: Dr. Vijay Pathak

4) Effect of Weak Measurement Reversal on Quantum Correlations in a Correlated Amplitude Damping Channel, with a Neural Network Perspective

Collaborators: Dr. Ashutosh Singh, Dr Venkat Abhignan

Publications:

1. V. Kumar, M. P. Singh, R. Srikanth, Concatenating quantum error-correcting codes with decoherence-free On the Physical Basis for the Incomparability of NP and BQP, Quanta 14, 38–47 (2025).
2. V. Abhignan, R. Srikanth, Twin-field-based multi-party quantum key agreement. JOSA B Vol. 41, No. 12 (2024)
3. Dash N.R., Dutta S., Srikanth R., Banerjee S. Concatenating quantum error-correcting codes with decoherence-free subspaces and vice versa (2024) *Physical Review A*, 109 (6), art. no. 062411.

Sponsored projects (2024 - 2025)

1. "Qubit and higher dimensional non-unital non-invertible quantum dynamical maps: geometry and the relation to quantum non-Markovianity" Funding: Rs. 26.7 L (DST-SERB project 2023 - 2025)
2. "Designing of Devices and Protocols for Quantum Hacking, Random Number Generation and Secure Communication" Funding: Rs. 20 L Interdisciplinary Cyber Physical Systems (ICPS) program of DST, India (with Prof Anirban Pathak) 2020 - 2024

Highlights of Research Activities at PPISR

We are steadily making progress in highly competitive scientific research and is coming into limelight on the national and international stage by maintaining the uniqueness in the research field. The Institute has chosen contemporary frontier areas of research in the fields of Materials Science and Catalysis, Biological Science and Theoretical Sciences. PPISR is successfully forging ahead a fruitful academia-industry partnership by innovating, designing and developing novel multifunctional materials that have wide-ranging applications in catalysis, nanotechnology, etc. Several new research projects have been initiated with sponsorship from industries like, SABIC Agri Nutrients and SABIC Research and Technology, Bengaluru and also Government agencies like Department of Science and Technology, Government of India, Defence Research and Development Organization , etc. Currently, 15 doctoral students are actively involved in research activities on many sponsored projects both from Government agencies as well as from industries.

PPISR has been pursuing nearly 29 research projects in different areas which are both fundamental as well as applied sciences. These projects have shown significant progress in terms of publications and patents.

ACHIEVEMENTS

Award of PhD degree:

Dr. Bhavana B. Kulkarni.: Dr. Bhavana B. Kulkarni was awarded PhD on "Studies on Metal-Organic Frameworks (MOFs) Catalysis for Valorization of Biomass-Derived Chemicals" by Manipal Academy of Higher Education (MAHE), Manipal on September 25, 2024 under the guidance of Dr. Sanjeev P. Maradur.

DST INSPIRE Fellowship:

Ms. Asha Devi, who is working under the guidance of Dr. Naresh Nalajala has been awarded DST-Inspire fellowship. She is the second Inspire student from our institute.

Best Presentation award

Based on the ongoing research projects, our faculty members and research scholars of have attended many National/International conferences held at various locations in India and won many best presentation awards.

1. Dr. Ananda K (Dean & Associate Professor, Biological Sciences Division) Received first prize under oral presentation award in an International conference "The Role of Fungi in Sustainable Development: From Exploration to Application" conducted by the Association of Fungal Biologists (AFB-CON 2024) on October 23-25, 2024.
2. Ms. Meghana H K received the Best ORAL Presentation Award at National Conference on "Catalysis for Energy Environment and Sustainability" and the 3rd CO_2 India Network organized by CSIR-IICT, Hyderabad under the aegis of Catalysis Society of India from 18-20, September 2024 .
3. Ms. Asha devi received "Best Oral Presentation Award" during the prestigious national conference on condensed matter physics and applications (CMPA-2024) conducted by MAHE, Manipal on December 13-14, 2024.
4. Ms. Chaitra won the best oral presentation award for her work at the 24th National Symposium on Catalysis (CATSYMP-24), "Catalysis for Sustainable Chemicals, Materials & Energy'' (CSCME-2025) was organized by Thapar Institute of Engineering & Technology, Patiala, from the 24th -26th of February, 2025.

Industry Sponsored Projects:

1. Synthesis of sulfates and carbonates from phosphogypsum and silicates via carbon dioxide mineralization.
Sponsored by: SABIC Research and Technology Pvt. Ltd.,
Duration:7 months (June 2024-December 2024)
Funding: Rs. 13.2 lakhs
Principal Investigator: Dr. Sanjeev P. Maradur& Dr. Ganapathi V Shanbhag
Co-investigator: Dr. Naga Suresh Enjamuri
Project Fellows: Mr. Kaviraj,Mr. Ganesh,Ms. Harshitha, Mr. Magudeshwaran and Mr. Karthikayan
Status: The SABIC project Completed

2. Next Generation Cellulose Based NP Fertilizers
Sponsored by: SABIC Research and Technology Pvt. Ltd.,
Duration:45 days (October 2024-November 2024)
Funding: Rs. 1.5 lakhs
Principal Investigator: Dr. Sanjeev P. Maradur& Dr. Ganapathi V Shanbhag
Co-investigator: Dr. Naga Suresh Enjamuri
Project Fellows: Mr. Magudeshwaran
Status: The SABIC project Completed

Government agencies sponsored projects:

1. Designing of devices and protocols for quantum hacking and secure communication
Sponsored by: Department Of Science And Technology, (DST-SERB), Govt of India
Principal Investigator: Dr. R. Srikanth
Duration: 2021-2024
Status: Ongoing

2. Emergence of quantum criticality for hermitian and non-hermitian topological state of quantum matter
Sponsored by: Department of Science and Technology,
Principal Investigator: Dr. Sujit Sarkar
Duration: 2022-2024
Status: Ongoing

3. Qubit and higher-dimensional nonunital noninvertible quantum dynamical maps: geometry and the relation to quantum non-Markovianity
Sponsored by: DST SERB for core research grant has been accepted for providing grant money to hire an RA
Principal Investigator: Dr R Srikanth
Duration: 2023-2026
Status: Ongoing

4. Design and development of rooftop photocatalyst panels for solar H2 generation and value-added chemicals
Sponsored by: Science and Engineering Research Board (SERB), DST under the startup research grant (SRG)
Principal Investigator: Dr. Naresh Nalajala
Student: Mr. Manjunath Reddy G

Status: Ongoing

5. Shape-engineered nanocrystals for solar H_2 and valuable chemicals from sunlights harvesting
Sposered by: Department of Science and Technology through Inspire doctoral fellowship from 2023-2028
Principal Investigator: Dr. Naresh Nalajala
Student: Ms. Ashadevi K. S.
Status: Ongoing

6. Semiconductor Oxide-Crystalline Framework Hybrid Gas Sensors: Advancing Hydrogen Detection Across a Wide Dynamic Range
Sponserd by: Board of Research in Nuclear Sciences with budget of 35 Laks with duration of 2024-2027.
Principle Investigator: Dr. Suresh Kalidindi
Co-Principle Investigator: Dr. Naresh Nalajala
Status: Ongoing

PUBLICATIONS (2024-2025):

1. B. B. Kulkarni; V. S. K. Reddy; S. P. Maradur "Upgrading of bio-derived alcohols: Selective synthesis of organic carbonates over acid-modulated MIL-101(Cr) MOF catalyst" Authors:, Industrial & Engineering Chemistry Research, 63 (2024) 9761-9771.
2. B. B. Kulkarni, S. P. Maradur "Tandem hydrogenation/hydrogenolysis of furfural to 2-methylfuran over multifunctional metallic Cu nanoparticles supported ZIF-8 catalyst", Bioresource Technology, 402 (2024) 130805.
3. K. S. Choudhari, R. Sai, K. S. Kanakikodi, S. P. Maradur, S. D. Kulkarni "Co2+-laddered heterojunction a next-generation solar-photocatalyst: Unusually improved activity for the decomposition of pharmaceuticals, dyes, and microplastics" AD Lopis, , Materials Research Bulletin 176, (2024) 112836.
4. A. Shetty, D. Sunil, T. Rujiralai, S. P. Maradur, AN Alodhayb, G Hegde "Sustainable carbonaceous nanomaterial supported palladium as an efficient ligand-free heterogeneouscatalyst for Suzuki–Miyaura coupling" Nanoscale Advances 6 (2024), 2516-2526.
5. A. D. Lopis, K. S. Choudhari, B. B Kulkarni, S. P. Maradur, S. D. Kulkarni "pH independent adsorption: Reusable zinc-ferrite nanospheres for the selective recovery of dyes from binary mixtures", Journal of Water Process Engineering 66 (2024) 106013.
6. K. Pallavi, B. Sumit, S. Sandip, M. Sanjeev, A. Supale "Synthesis of tetrahydrobenzo[b]pyran derivatives using a novel zirconia supported sodium hexamolybdochromate(III) catalyst", Reaction Kinetics, Mechanisms and Catalysis 138 (2024) 873-888.
7. K. Menon, A. D. Lopis, K. S. Choudhari, B. Kulkarni, S. Maradur, S. D Kulkarni "Scavenger-free solar photocatalytic degradation of Textile Dyes and Antibiotics using magnetically separable bi-junctional photocatalyst", Materials Research Bulletin 181 (2025) 113074.
8. C. N. Mallannavar, S. Sujith, S. D. Patil, S. P. Maradur and G. V. Shanbhag "Bimetallic oxide catalysis meets silanol-enhanced synergy: A winning combination for efficient CO2 fixation by cycloaddition with styrene oxide", Molecular Catalysts 579 (2025) 115029.
9. K. Kalidasan, S. Mallapur, B. B Kulkarni, S. P Maradur, D. Kumar, R Deeksha, S. Kandaiah, P. Vishwa, S. G. Kumar "Gadolinium modified g-C3N4 for S-Scheme heterojunction with monoclinic-WO3: Insights from DFT studies and related charge carrier dynamics", Journal of Materials Science & Technology 204 (2025) 166-176.

10. A. D. Lopis, K. Menon, K. S. Choudhari, B. Kulkarni, S. P. Maradur, S. D. Kulkarni "Solar-driven plasmon-enhanced photocatalysis: Co 2+-doped ZnFe 2 O 4 nanospheres-embedded ZnO nanosheets for effective degradation of dyes and antibiotics", Nanoscale Advances 7 (2025) 1727-1735.
11. M. P. Shilpa, K. S. Ashadevi, S. J. Shetty, S. S. Bhat, N. Nalajala, V. Mishra, M. R Waikar, R. G Sonkawade, SC Gurumurthy, Noble metal decorated $Ti_3C_2T_x$ MXene for room temperature SO_2 detection, Sensors and Actuators A:Physical, 388, (2025) 116492.
12. C. Aranthady, A. K. Mishra, K. Gupta, Ganapati V. Shanbhag,Nalini G Sundaram "Bi_2WO_6 gas sensors for low concentration CO sensing: Experimental and computational studies", Materials Science and Engineering: B., **313**, (2024) 117960.
13. N. Enjamuri, So Nishikawa, M. Nishijima, S. Tada, R. Kikuchi. Highly active and stable Ru promoted Ni/CeO_2 catalysts for CO_2 methanation reaction. ASAP Article, The Canadian Journal of Chemical Engineering, 13, 2025.
14. V. Kumar, M. P. Singh, R. Srikanth, Concatenating quantum error-correcting codes with decoherence-free On the Physical Basis for the Incomparability of NP and BQP, Quanta 14 (2025) 38–47.
15. V. Abhignan, B. B. Boruah, R. Srikanth, A. Singh, Effect of Weak Measurement Reversal on Quantum Correlations in a Correlated Amplitude Damping Channel, with a Neural Network Perspective., Phys. Scr. 100 (2025) 075120. arXiv:2506.05642
16. N.R. Dash, S. Dutta, R. Srikanth, Banerjee S. Concatenating quantum error-correcting codes with decoherence-free subspaces and vice versa, *Physical Review A* (2024) 6, art. no. 062411.
17. V. Jagadish, R. Srikanth, Eternal non-Markovianity of qubit maps, , Phys. Rev. A 111 (2025) 042212. arXiv:2501.06846
18. V. Abhignan, R. Srikanth, Twin-field-based multi-party quantum key agreement. JOSA B., 41, (2024) 12.
19. D. Dwarakanath, Y. N. Nayak, A. Kulal, S. Pandey, K. S. R. Pai, S. L. Gaonkar, In vitro and in silico insights into antimicrobial and anticancer activities of novel imidazo[2,1-b][1,3,4] thiadiazoles Scientific Reports 14 (2024) 31994.
20. D. Dwarakanath, Y. N. Nayak, A. Kulal, S. Pandey, K. S. R. Pai, S. L. Gaonkar, Synthesis, characterization and in silico studies of novel multifunctional imidazole-thiazole hybrids with potent antimicrobial and anticancer properties. Scientific Reports, 15, (2025) 9809.
21. D. Dwarakanath, A. Kulal, B. Basappa, Z. Xi, V. Pandey, B. R. Bharath, S. L. Gaonkar, Synthesis, computational studies and evaluation of benzisoxazole tethered 1,2,4-triazoles as anticancer and antimicrobial agents, Journal of Molecular Structure, 1308 (2024) 138070.
22. S. Gupta, Y. M. Puttaiahgowda, A. Kulal, Development and evaluation of antimicrobial PVC-grafted polymer for enhanced paint applications, *RSC Advances*, **14** (2024) 25669-25677.
23. S. Gupta, Y. M. Puttaiahgowda, A. Kulal, Unveiling the effectiveness of antimicrobial BPJ polymer coatings in enhancing microbial resistance, Materials Advances, **5** (2024) 5855-5869.
24. S. S. Rao, S. V. Kundapura, D. Dey, C. Palaniappan, K. Sekar, A. Kulal, U. A. Ramagopal. Cumulative phylogenetic, sequence and structural analysis of Insulin superfamily proteins provide unique structure-function insights.*Molecular Informatics.* (2024) e202300160.
25. Sarkar, S. Topological transition on a conformal manifold for the quantum Ising model with a longer range interaction, Scientific Reports**,** 15 (2025) 5916.

Manuscripts under communication:

Nearly 21 manuscripts are in the process of submission/review

Academics

The course work for the new batch of Ph.D. students has been started and DAC reports are being sent to Manipal University periodically. The Doctoral Advisory Committee and Research Advisory Committee are being held periodically to further improve the quality of research work carried out in all three areas of sciences.

In-house Seminars and Invited Lectures

We had organized 20 In-house seminars based on the research work carried out by faculty and students of PPISR. Few eminent scientists both from India and abroad visited PPISR and also delivered an Invited lecture in all three areas. Throughout 2024, PPISR hosted a series of enlightening invited lectures and webinars delivered by esteemed experts across diverse scientific domains. On July 11, 2024, Prof. Ranga Rao G. from the Department of Chemistry at IIT Madras visited the Bidalur research campus and presented an impactful talk on "Urgency and Newer Ways of Generating Green Hydrogen." Dr. Keshavaraj A., Technology Team Leader at SABIC (a Saudi Aramco Company), shared his personal and professional insights through a lecture titled "My Journey in Industrial R&D and My Learning" on July 22, 2024. Prof. Nabyendu Das from the Department of Physics at The LNM Institute of Information Technology, Jaipur, delivered an in-depth lecture on "Higher-Order Topology and Bulk-Boundary Correspondence in a Two-Dimensional SSH Model" on 5 September 2024. Additionally, on 13 September 2024 Dr. Timmanna Bennur, Senior Group Leader at Eurofins Advinus Pvt. Ltd., captivated the audience with his talk on "Drug Discovery and Development." These sessions served as valuable platforms for knowledge exchange, fostering. On 09/12/2024, Prof. N. D. HariDas, Former Director of PPISR shared his insights on "Can Science be resurrected from the quick sands of its teaching". Dr. Puneet Kumar, young researcher from Jain University shared his expertise on "Engineered porous metal/mixed metal oxides catalysts for sustainable utilization of CO2 in organic transformations" on 20 March 2025.

Project Internship programme:

Nearly 30 students from various colleges/universities in and around Karnataka, as a partial fulfillment of the requirement for the award of Masters degree, completed their MSc projects under the guidance of all faculty members of PPISR

Memorandum of Understanding (MOU) with reputed organizations:

On June 6, 2024, PPISR signed a MoU with QDit Labs to foster collaboration in advanced research and technology development. The MoU was signed by Prof. A. B. Halgeri, Director of PPISR, and Dr. R. Srikanth on behalf of PPISR, while Mr. Animesh Aaryan and Prof. Satheesh K represented QDit Labs. Subsequently, on December 17, 2024, another significant MoU was signed between PPISR and ICFRE- IWST, Bengaluru. Dr. Ananda K. represented PPISR during this signing.

Visit of Scientists from SABIC Research and Technology, Ltd.

On August 9, 2024, PPISR had the privilege of hosting Dr. Sadeq Raeid, Lead Scientist at SABIC, Saudi Arabia, and Dr. Ravi Hegde, Lead Scientist at SABIC Research and Technology Ltd., India. The esteemed guests visited the institute to review the progress of two ongoing collaborative projects and to explore the state-of-the-art research facilities at PPISR. Their visit not only strengthened the ongoing partnership but also provided valuable insights and direction for future scientific advancements.

Founder's Day 2024:

Founders Day 2024 was celebrated on July 4, 2024, at PPISR Bidalur campus. Sri. Subramanya Katti, the Managing Director of Hongirana Energy Private Limited was the Chief Guest of the day. Dr. Anand B. Halgeri, Director of PPISR presided over the function along with Dr. Ganapati V. Shanbhag (Dean (Academics) PPISR). The Program had began with an invocation by Ms. Ashadevi, Research Scholar, MS&CD. Dr. Anand B. Halgeri, the Director, welcomed the gathering and addressed them. In his address he briefly explained about the various activities and the achievements of PPISR for all these many years. Followed by the welcome address, lighting of the lamp was performed by the dignitaries. Then, Dr. Ganapati V. Shanbhag gave an overview of the progress of the institute. He spoke in elaborate about the founder Chairman H. H. Sri Vibudhesha Theertha Swamiji. Later on, the chief guest delivered a lecture after inaugurating the founder's day for the year 2024. Sri. Subramanya Katti, gave a technical and inaugural talk on "Bio fuels, A key transmission fuel". He spoke about the demands of fuel in India as well as globally and where we can contribute to the society by finding some innovative research works on biofuel. After his talks, the vote of thanks for the inaugural session was conclude by Dr. Sanjeev P. Maradur, Associate Professor, MS & CD, PPISR. After the tea break the, technical session began. Dr. Ganapati V. Shanbhag, Dean, HOD & Associate Professor, Materials Science and Catalysis Division chaired the session. Finally, Dr. Ananda K, in his concluding remarks recalled all the activities of the whole day program and thanked every speakers, all participants and those who were directly or indirectly involved to make this event a successful one.

Fellow of Royal Society of Chemistry (FRSC) Recognition

Dr. Ganapati V. Shanbhag, Dean (Academics) and HOD, Materials Science and Catalysis Division, PPISR received the prestigious recognition of Fellow of Royal Society of Chemistry (FRSC) London in September 2024 for his contributions in the area of Chemical Sciences. He has been working in the area of heterogeneous catalysis, adsorption, synthesis of fine and specialty chemicals, petrochemicals and agrochemicals for more than 16 years post his PhD at CSIR-NCL, Pune.

Celebration Of 77th Independence Day At Bidalur Campus:

PPISR celebrated Independence Day with great enthusiasm on August 15, 2024. The event began with the ceremonial hoisting of the national flag by Dr. A. B. Halgeri, Director of PPISR and the Chief Guest for the occasion. Dr. Halgeri also delivered an inspiring address, emphasizing the values of freedom, responsibility, and progress. Following the speech, sweets were distributed and breakfast was served to all attendees. The celebration concluded with a collective effort under the "Swachh Bharat

Abhiyan" initiative, where faculty members, research scholars, and staff actively participated in cleaning laboratories, workspaces, and collecting plastic waste from open areas across the campus.

Outreach Programme for PPEC Schools:

In order to create interest in basic science in young minds, PPISR has taken up an initiative of outreach program with a theme *"Today's Science for Tomorrow's Scientists"* for Poornaprajna School students since 2013. This year, students of IX standard from five Poornaprajna Schools in Bangalore visited PPISR one day each as a part of the outreach program to be held for 5 days from 11-15th November 2024. Dr. Sanjeev P. Maradur served as the coordinator, and a team of doctoral students showcased a range of experiments from different departments. All the students were taken for a laboratory visit and given explanation of the research facilities that are available in the institute. Nearly 515 students and 20 teachers participated in this programme. Overall, the response was overwhelming and all the teachers requested to conduct this programme in the near future too.

Chemistry Day celebrations

To commemorate the birth anniversary of Acharya Prafulla Chandra Ray, revered as the Father of Chemistry in India, PPISR organized a special Chemistry Day celebration on August 2, 2024. The event paid tribute to Acharya Ray's pioneering contributions to science and education. The highlight of the program was the inaugural lecture delivered by the Chief Guest, Dr. Gururaj M. Shivashimpi, Founder and CEO of SudhiShubhaChemSynthons LLP, Bengaluru, who spoke on "The Role and Challenges in Science and Technology." The celebration also featured an insightful presentation by Ms. Asha Devi K.S., a dedicated doctoral student, titled "Acharya and Chemistry," which shed light on the profound legacy of Acharya Ray. The event was a fitting homage to a legendary scientist whose work continues to inspire generations.

National Science Day Celebrations:

PPISR observed National Science Day on March 05, 2025, under the theme of Science and Technology Advancements. The event commenced at 10:00 am with a warm welcome by Ms. Chaitra M. This was followed by the esteemed presence of our revered director (Incharge) Dr. Ananda K and our chief guest Dr. Visweswara Rao, Director, International Relations and Research Collaborations, REVA University, Bengaluru, along with other invited speakers (Dr. Ganga Periyasamy, UGC-Recharge Assistant Professor, Department of Chemistry**,** Bangalore University, Bengaluru, Dr. Sijo Joseph, Assistant Professor**,** Department of Physics, GITAM deemed to be University, Bengaluru), guests, faculty, participants from Vihan Public School and GITAM and students, graced the occasion. The event's tone was set by the invocation led by Ms. AshaDevi. Dr. Ananda K delivered the welcome address by introducing the each and every guests, participants, faculty, and students. Followed by, Dr. Sanjeev Maradur, Associate Professor & HoD at Materials Science and Catalysis Division (MSCD) enlightened the audience about the importance of celebration and inspired with note about the remarkable discovery of Indian Scientist Sir C. V. Raman, "The Raman Effect". The inauguration ceremony was conducted by our chief guest, Dr. Viswaswarao, who illuminated the ceremonial lamp along with our director and other invited speakers.

The scientific talks commenced with an invited presentation by our chief guest Dr. Visweswara Rao on "Advancements in Ethnopharmacology for Metabolic diseases". Dr. Naresh got the opportunity to introduce the

speaker to the audience. Dr. Rao provided an insight about the importance of herbal research in the context of well being of human society. Moreover, he highlighted the importance of RICE approach for successful research endeavors of a researcher; RICE defined for Research, Innovation, Commercialization and Entrepreneurial. As a token of appreciation, our Director facilitated the guest.

Followed by, Dr. Ganaga Periyasamy delivered an insightful lecture about the "High-Throughput Computational Chemistry: Accelerating Materials Discovery". Before listening to her talk, Dr. Sanjeev introduced the speaker to the audience. During the talk, the speaker enlightened the audience with the potential of computational chemistry in relevance to materials science applications including electrocatalysis, photocatalysis, solar cell, magnetic properties and interfacial chemistry in specific to gold nanoparticles. After the talk, Dr. Ganga Periyasamy was facilitated by both Director and HoD of MSCD.

Followed by Dr. Sijo Joseph delivered a vibrant talk on "Hybrid Continuous Variable Quantum Computing (CVQC) with Orbital Angular Momentum (OAM)". Before listening to, Dr. Srikanth Associate Professor & HoD of Theoretical Science Division (TSD), introduced the speaker to the audience. The speaker provided the knowledge based on quantum computing with underline principles of working mechanism, and emphasized the role and need of experimental studies for validating the theoretical understanding of quantum computing. On this occasion, audience happy to know that, Prof. Sudarsanam, an Indian quantum physicist has given the breeding ground for development of quantum computing. After the talk, Dr. Sijo Joseph was facilitated by both Director and HoD of TSD.

Retirement of Mr. Kishore L. Gaikwad

PPISR bid a heartfelt farewell to Mr. Kishore on August 30, 2024, in recognition of his dedicated service. Mr. Kishore served the institute with commitment and integrity for nearly 15 years as an Administrative and Senior Administrative Officer. Even after his retirement, he graciously continued to contribute for an additional two years. His unwavering support and administrative acumen have been instrumental in the smooth functioning of PPISR. The farewell function, held in his honor, was a gesture of gratitude for his invaluable contributions to the institution.

Farewell to Dr. Ganapati V. Shanbhag

PPISR bid a warm and heartfelt farewell to Dr. Ganapati V. Shanbhag on October 3, 2024, honoring his remarkable service to the institute. Over nearly 14 years, Dr. Shanbhag served with unwavering dedication and integrity in various roles, including Faculty, Head of Department, and Dean. During his tenure, he successfully led several industry- and government-sponsored projects, published impactful research articles, and guided seven Ph.D. scholars to completion. The farewell function was a sincere expression of gratitude for his invaluable contributions to the growth and excellence of the institution.

POORNAPRAJNA ANALYTICAL CENTRE (PAC)

In order to strengthen technological infrastructure to carry out advanced research in various science disciplines under one roof and make their services available for the faculty and students to carry out globally competitive r & d in basic and applied sciences, PPISR has procured several analytical instruments namely powder x-ray diffractometer, fourier transform infrared spectroscopy (FTIR) ultra violet–visible spectroscopy (UV-Vis), atomic absorption spectroscopy (AAS), fluorescence spectrophotometer, temperature program desorption (TPD) analyzer and surface area analyzer etc., that are necessary for general analysis. The aforementioned instruments are available for use mainly by the scientists and the research students at PPISR and our collaborators. This facility is also extended to all researchers from academic institutions and industries, to characterize their samples at nominal charges under the guidance of highly qualified PPISR staff. The following instruments are available for external users.

1	**Powder X-ray diffractometer (PXRD)** The D2 phaser–table top xray powder diffractometer from brukeris ideal for qualitative, quantitative and structure analysis of polycrystalline samples.	
2	**Fourier Transform Infrared Spectroscopy (FTIR)** The Bruker-Alpha FTIR spectrophotometer is a compact instrument and measures the infrared spectrum, which represents the molecular absorption and transmission of a sample.	
3	**Fluorescence spectrophotometer** The varian cary eclipse fluorescence spectrophotometer is a compact instrument and measures the fluorescence, phosphorescence, chemi/bio-luminescence, and time resolved phosphorescence.	
4	**Ultraviolet–visible spectroscopy** The UV-Visible spectrophotometer from Perkin elemer can be routinely used in analytical chemistry for the quantitative determination of different analytes such as transition metal ions, highly conjugated organic compounds, and biological macromolecules.	

5	**Atomic absorption spectroscopy (AAS)** This instrument from PerkinElmer is used for the qualitative and quantitative determination of chemical elements employing the absorption of optical radiation (light) by free atoms in the gaseous state. In analytical chemistry, the technique is used for determining the concentration of a particular element (the analyte) in a sample to be analyzed	
6	**Temperature program desorption (TPD) analyzer** Bel's new fully-automated catalyst analyzer, enables comprehensive catalyst study by using the techniques; 1) temperature programmed desorption (TPD) 2) temperature programmed reduction (TPR) belcat ii will be the strong tool for the catalyst evaluation.	
7	**Surface area analyzer** Belsorp-miniii is a compact, volumetric adsorption measurement instrument used for specific surface area and pore distribution measurement. Up to 3 samples can be measured simultaneously and independently with dedicated software, which makes operation of the instrument straightforward.	
8	**Thermo gravimmetric analyzer (TGADTA/DSC)** Sta6000 (Perkin Elmer) is simultaneous thermal analyzer for simultaneous measurement and analysis of weight change and heat flow	

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